

City Council Utility Committee

Meeting Agenda

Friday, November 9, 2018

**CONFERENCE ROOM, HOWARD BERRY TREATMENT
PLANT (7000 Marshall Road)
2:30-4:00 pm**

- I. Call to Order
- II. Roll Call
- III. Approval of Agenda
- IV. Approval of Minutes from June 22 and September 28, 2018
- V. Public Comments on Items Not on the Agenda
- VI. Agenda Items and Date for Next Meeting
 - Advance Agenda & Meeting Dates
- VII. 2019 Utility Rates
- VIII. Update – Trash RFP
- IX. Update – CIP Projects
- X. Update – Water Resources
 - Water Supply Update
 - i. Master Plan Review
 - Windy Gap Firing Project Update
- XI. Upcoming Projects and Council Action
 - SCWTP Tube Settlers Replacement Construction – Nov. 27th
 - Louisville Pipeline Control Vault Construction – Dec/Jan
 - Consulting Water Engineers Contract - Jan
 - SWSP Transmission Capacity Design – 1st QTR
 - SCWTP Building Upgrades – 1st QTR
 - SCWTP Disinfection Design and Construction – 1st QTR
 - Windy Gap Financing – Spring
- XII. Adjourn 4:00 pm
- XIII. Tour of HBWTP

Attachments: 6-22-18 & 9-28-18 Draft Minutes

Advance Agenda

Rate Presentation

CIP summary

Before & After Photos

Supply Forecasts

Master Plan

City Council Utility Committee Draft - Meeting Minutes

Friday, June 22, 2018

CITY COUNCIL CHAMBERS, CITY HALL, 2nd FLOOR

I. **Call to Order** –Councilmember Keany called the meeting to order at 2:35 pm.

II. **Roll Call** was taken and the following members were present:

City Council: Councilmember Keany and Councilmember Stolzmann

Absent: Mayor Muckle, Mr. Watson

Staff Present: Mrs. Balser, Mr. Kowar, Mr. Peterson, and Mrs. Golden

Public: none

III. **Approval of Agenda:** Agenda approved as written.

IV. **Approval of the Minutes:** The meeting minutes from May 11th will be reviewed/approved at the September 14th Utility Committee meeting.

V. **PUBLIC COMMENTS ON ITEMS NOT ON THE AGENDA:**

None

VI. **AGENDA ITEMS AND DATE FOR NEXT MEETING**

Councilmember Stolzmann noted that this has been moved up on the agenda so we don't miss anything at the end of the meeting. The next meeting is scheduled for July 20th at 2:30 p.m. Agenda Items are: Rates, Windy Gap, and CIPs.

Councilmember Stolzmann asked if the CIP will be before or after the Council Meeting in August. City Manager Mrs. Balser confirmed after. Mr. Peterson commented the CIP is an update on status of the various projects. Councilmember Stolzmann sought clarification on the trash RFP. Mr. Kowar stated that the RFP was progressing and that trash fees are on schedule but our outreach for commercial and multi-family hasn't taken effect yet. Councilmember Stolzmann mentioned to use the City Council Members to reach out to the HOA members as it might make it easier. Mr. Kowar will make an info graphic to

City of Louisville

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compare rates. The RFP is scheduled for July/August and go to council shortly after that.

VII. Update – CIP Projects

Councilmember Stolzmann stated that Mr. Peterson updated the water sheets with our comments from the last meeting. Mr. Peterson stated the CIP sheets that changed have a red border around them. Councilmember Stolzmann noted that the Marshall Lake Sediment Control CIP sheet did not appear to change. Mr. Peterson stated the original sheet was correct and the error was in the summary forecast, both the CIP sheet and Financial Model match. Mrs. Balser stated two of the CIPs have been delayed and moved to 2027 but are still in the 10-year plan within the Model. Mr. Peterson stated the Sediment Control may need to be moved up early with the desire to perform a Bathymetric Survey in 2018. This survey will provide detailed contour information of existing conditions within Marshall Lake. Mr. Peterson also noted that FRICO recently inspected the Marshall Lake Outlet works with a dive team and a significant amount of sediment was encountered during this inspection. Councilmember Stolzmann asked if it's too late to associate with the flood. Mr. Peterson commented that while the flood was a substantial contributor to the sediment loading in Marshall Lake, this issue has most likely been developing over time. Mr. Kowar stated that staff is working with FRICO on cost sharing of this operation.

Wastewater

Councilmember Stolzmann sought clarification on why the Sewer Line Replacement forecast numbers changed from prior years. Mr. Peterson replied that several lines within CTC had been moved forward to be performed earlier. Councilmember Keany inquired into the cost allocations 5-6 years out and asked which pipes will be done each year of logistics, details and data. Mr. Kowar went on to explain and Councilmember Stolzmann stated we should make a note that these out years are likely to change based on field inspections. Mr. Kowar stated that pipe segments are rarely removed and typically just rearranged based on the most up to date information.

Reuse System Replacement

Mr. Kowar stated this project will be for the replacement of the filter media cloths and the addition of a control valve. Additionally, one of the current reuse pump is inoperable. He went on to explain this pump may need to be replaced as it is 14 years old and this operation is critical for the City's drought response. Councilmember Stolzmann said that the description states filters need replaced every 5 years. Mr. Peterson explained that this statement was more of an industry standard and the actual life span is based on usage which is not as consistent under current operations. Therefore, the next replacement was delayed until more information is collected. Once this is determined it will be incorporated into a future CIP sheet.

WWTP Vehicles

The goal for the tractor CIP was to get a multi-purpose vehicle that can mow, has Fork for chemical tote transportation and allow for the removal and movement of

plant equipment. Mr. Kowar stated we have a lot of grass to mow as the Reuse ponds are now filled in. Councilmember Stolzmann asked if it would be better to contract this service versus buy the equipment. Mr. Kowar explained each facility needs their own equipment. Mr. Kowar said this project was vetted and was the preferred approach. Additional information on the alternative analysis will be provided prior to the July 12th Council Budget discussion.

Drum Thickener

Mr. Kowar described this as a critical piece of equipment within the wastewater treatment process. It is an older unit and we are being proactively replacing this one as it has long lead times.

Dewatering

Mr. Kowar explained this is another replacement that is needed as it's an older unit and has a long lead time as well.

Influent Pump

Mr. Kowar explained this is the addition of a sixth pump at the influent pump station. This replacement is needed to provide faster recovery and more redundancy at this location. Councilmember Stolzmann asked about the Lift Stations. Mr. Kowar stated that the City has three operational lift stations: Steel Ranch, North End and CTC. Storage Tech is private and not active. Mr. Kowar went on to discuss the recent problems at the Steel Ranch Lift Station and what was required to get it up and running.

Probes

Mr. Peterson explained how the installation of new probes will allow for better real time information coming back to the system leading to the optimization of the process. Mr. Kowar highlighted his recent tour of the wastewater plant and discussed the automation process. Staff continue to optimize and get more sophisticated in the operations. As an example the wastewater plant is running off MCRT that is providing higher accuracies.

A-Basin Mixer

Mr. Kowar described the issue of a buildup of a grease layer in the first chamber of the aeration basin prior to be being distributed to any of the three basins. The goal of this project will be to breakup this grease by the addition of new mixers.

Vibration and Monitoring

Mr. Peterson describes the addition of new monitoring equipment on the various pumps that will provide direct feedback on the pump performance in comparison to their tolerances. This real time data can be tracked within the SCADA System allowing for better asset control. The monitoring also provides a greater level of sensitivity beyond a typical visual inspection improving the timeliness of detection and the subsequent maintenance and repair response.

Lights

Councilmember Stolzmann asked if we can do this for less and Councilmember Keany asked if there are lights out there now. Mr. Peterson answered the

existing site area does not currently have lights and staff utilize head lamps and flashlights to perform any requirement work in these areas. Project will include 8-10 lights around the digesters and reuse tank.

Asphalt

Councilmember Stolzmann asked for clarification on the cost estimating. Mr. Peterson stated the area to be paved is from the RAS/WAS Building to the Maintenance Building. Cost projections were based on recent City projects and are comparable for the size of the area. The project will either be bid individually or as an alternative in the street pavement program.

Vac Truck Dump Station

Councilmember Stolzmann asked about the process and the need for this project. Mr. Kowar explained the current process of emptying the vacuum truck whereby collected material is stocked piled at the WWTP and eventually taken to the landfill. This project will allow for the decanting/dewatering of all materials and the ability to route those materials that can be placed into the treatment process in to the new plant. Councilmember Stolzmann asked what it would cost to dispose of it without treating it. Mr. Kowar said it would be on a weight/wet ton basis. The discussion continued and Councilmember Keany asked for additional detail on what is being proposed. Mr. Kowar & Mr. Peterson explained the process and discussed a large sealed container and associated offloading ramp that would allow for a more efficient emptying of the Vac Truck improving the down time of this equipment. Time management is critical as these situations typically occur as a result of a sewer break or other emergency conditions. Mr. Kowar stated that the budget will be more defined as the final configuration is completed.

Storm Sewer Detention Pond Maintenance

Councilmember Stolzmann asked which of the storm ponds in the City were covered by this project. Mr. Kowar and Mr. Peterson explained the list of covered ponds is directly from the stormwater master plan. Councilmember Stolzmann is concerned about the storm water detention by Hwy 36 & McCaslin Blvd. by the theaters as it is overgrown with trees, etc. and was not listed as one of the future locations. Mr. Peterson will investigate this location and provide a response. Councilmember Keany mentioned his concern is the citizens don't get advance notified of which areas are going to be cleaned. Mr. Kowar noted this concern and will evaluate the possibility of putting up signage prior to work being performed in an area. Mr. Kowar mentioned that this work is typically included on the CIP status update page on the City's website. Councilmember Stolzmann shared her interest in stormwater and was in favor of this project. Mr. Kowar will provide the stormwater master plan

Railroad Underpass

Councilmember Stolzmann asked how the division of funds on the BNSF Railroad underpass was determined. Mr. Kowar stated the split of funds was set at the initial onset of the project in 2016 and was approved by City Council. Councilmember Stolzmann asked if the project was still at 63% form the

stormwater fund. Mr. Kowar stated that this was correct but final division of funds may vary slightly based on actual construction expenses.

Street Sweeper

Councilmember Stolzmann asked if the replacement street sweeper can be sized small enough to meet the clearances for the garage under the library instead of contracting this area. Mr. Kowar said he will have to look into it. Mr. Kowar also noted that this item may need to be moved up into 2018 as the current street sweeper is having mechanically and reliability issues. Councilmember Stolzmann requested further analysis of the cost effectiveness of purchasing versus contracting. Discussed the street sweeping service after City events, etc. Mr. Kowar will have staff investigate this option and provide follow up to the Utility Committee.

Stormwater Quality Master Plan

Councilmember Stolzmann asked if this project had funds for improvements or was only for the study. Mr. Peterson explained the study is scheduled for the first year of funding and the remaining budget in 2020 through 2023 is for completing projects identified during the study. Mr. Kowar noted the possibility that the newly identified projects could exceed the budget estimate.

Goodhue Ditch Stormwater Diversion

Councilmember Stolzmann asked if this is moved out. Mr. Peterson said it is actually moved up and in the current 2018 budget and potentially tied to the Coal Creek Station project.

Sanitary Sewer Maintenance Equipment

Mr. Peterson stated this project is for the replacement of the Vac Truck. The project request was from an early year that was correctly listed on the forecast but a new CIP sheet was not completed. Mr. Kowar stated this fell through the cracks and should be put back. Mrs. Balser stated that the sheet needs to get submitted as soon as possible. Mr. Kowar agreed and will add.

VIII. Financial Review

Mr. Kowar reviewed the options for funding these projects in all three utility funds. Options include the delay of projects, financing and rate adjustments. Mr. Kowar highlighted the options for the water fund that comprised of delaying two of the larger projects out of pasted the 6 year CIP plan. The wastewater fund has limited flexibility and less deviation from earlier projects and therefore only a single scenario was presented. The stormwater fund options included two surcharge scenarios and a financing scenario. Mr. Kowar further explained the financing scenario will result in significantly higher rates when compared to the surcharge options. As result, Staff would recommend one of the surcharge scenarios.

Councilmember Stolzmann requested additional information on future stormwater projects as well as a comparison of other funding options and or source as an alternative to the surcharge.

Mrs. Balser reiterated that based on the discussion, the CIP sheets were sufficient for the July 12th Council Budget meeting and the requested supplemental information would be provide before this date. Mr. Kowar went on to say that he was pleased with this rate process, appreciated the feedback and noted that the rate process was essentially complete barring changes from July 12th meeting. Mr. Peterson said the Financial Model is up to date as possible and will have a minor adjustment as the operations budgets are finalized.

IX. Water Supply Update

Mr. Peterson provided an update on the City's water supply, highlighting that the Water Supply Index has increased indicating an improvement in the City's supply and summer drought restrictions are not recommended. Marshall Lake storage levels are starting to lower which allows for the backfill of the reservoir with the running of the Baseline Exchange. In addition, Northern has started pumping Windy Gap water with the last pumping operation about 6 years ago. In general, water supply storages are within typical ranges and no problems are anticipated for the reminder of 2018.

Windy Gap

Mr. Peterson explained the recent activities of the Windy Gap Firming Project. One of the items noted at the last meeting was the results of the geotechnical analysis which indicate that the soil characteristics under the dam abutment are insufficient. The projected remedy is to over excavate this area and replace with select fill ensuring a better base. This additional work is estimated to add \$4 to \$5 million to the total project cost.

Water Rights Decree and Case

Mr. Peterson said the water rights decree is still progressing. In regards to the federal lawsuit, briefings are scheduled for October. As result it is more likely that project financing will be delayed until early 2019. Mrs. Balser asked for schedule for updating Council. Mr. Peterson stated the pervious schedule had the Final costs and recommendation for January. The schedule will be updated and presented at the fall Utility Committee in September. Mr. Peterson went on to explain the case for timing purposes. With the pending delay likely, an additional interim payment to cover project costs is expected for 2019 and anticipated to be within range of the current budget.

Financial Review

Councilmember Stolzmann asked how the City was on our tap fees. Mr. Peterson stated revenues from tap fees are within a reasonable range of projections and will continue to be monitored throughout the year. Councilmember Stolzmann sought verification that the user fee line item was lagging as a result of corresponding demand. Mr. Peterson confirmed that this statement was correct and the summer charges were not yet included in the financial statement. Mr. Peterson highlighted that the current CIPs are mostly under construction and a large rollovers should not be expected for 2019.

X. Upcoming Projects and Council Action

Mr. Peterson provide a brief update on upcoming Council approvals related to Pipeline Inspection, Louisville Pipeline Control Vault, Water Tank Maintenance, SCWTP Tube Settlers Replacement and Windy Gap Financing.

XI. Adjourn

The meeting was adjourned at 4:45 pm.

City Council Utility Committee

Draft - Meeting Minutes

Friday, September 28, 2018

SPRUCE CONFERENCE ROOM, CITY HALL, 1st FLOOR

- I. **Call to Order** – Mayor Muckle called the meeting to order at 2:35 pm.
- II. **Roll Call** was taken and the following members were present:

City Council: Mayor Muckle and Councilmember Stolzmann

Absent: Councilmember Keany

Staff Present: Mrs. Balser, Mr. Kowar, Mr. Watson, Mr. Peterson, and Mrs. Golden

Public: none
- III. **Approval of Agenda:** Agenda approved as written.
- IV. **Approval of the Minutes:** The meeting minutes from May 11th were approved as written.
- V. **PUBLIC COMMENTS ON ITEMS NOT ON THE AGENDA:**

None
- VI. **Agenda Items and Date for Next Meeting**
 - Final 2019 Rates
 - 3rd Quarter Financial Review (2018)
 - Windy Gap
 - CIP Update
 - Project Tour (HBWTP)
 - Next meeting - Friday, November 9, 2018 at 2:30 p.m.

Discussion of items not on agenda.

Mayor Muckle asked about the possible ordinance changes related solid waste handling. Mr. Kowar stated that the City is modeling language similar to how Boulder County governs waste. The current plan is to advertise the contract hauling services RFP in November with a presentation to City Council around April 2019. Councilmember Stolzmann suggested a Utility Committee member should serve on the RFP selection committee. This opportunity will be provided to Councilmember Keany, with Mayor Muckle volunteering if Councilmember Keany was not available.

VII. 2019 Utility Rate Workshop

Mr. Kowar started the discussion by outlining the various rate projection iterations that have been completed and the desire to finalize this process in preparation for a recommendation. Councilmember Stolzmann asked for a walk through of the scenarios. Mr. Peterson explained the baseline is the rate model from last year that we used to adopt 2018 rates. Councilmember Stolzmann expressed a desire to have future baseline scenarios to represent the amended budget. Mr. Kowar commented that the scenarios are very dynamic and there is some difficulty in matching the other financial projections perfectly. Discussion continued about projections, percentages and expenditures.

Mr. Kowar went on to say the rate model matches the CIP that have been previously reviewed by Council and represents the Operational Budget that Council is currently reviewing. The major difference between the financial projections and the rate model are tied to more up to date revenues and expenditures as well as the delay in tap fees.

Councilmember Stolzmann sought clarification on why the budget plans for approximately 3-5% growth in operations increases and a rate increase is recommended at 0% for the water fund. This would indicate the reserve funds could be used for operations. Councilmember Stolzmann recommended that a rate minimum should be developed that would cover at least the increases in operational expenditures. Mayor Muckle was in favor of this recommendation. Mr. Peterson completed a quick calculation showing that the changes in operational costs in the water fund represent about at a 0.1% change in the overall rate. Mr. Kowar stated that additional detail will be added to the rate model, showing the portions related to operational and capital expenses. The Committee agreed to this approach.

Councilmember Stolzmann inquired to a large increase shown in the wastewater O&M budget for Wastewater Engineering. The total for this program is \$71,000 in 2018 and \$146,000 for 2019 and back to \$71,000 in 2020. Mr. Kowar explained this increase is tied to \$75,000 for additional sewer video inspection.

The discussion moved on to stormwater, where Mr. Kowar provide a summary of the various stormwater CIPs. The first project discussed, was the BNSF underpass. Mr. Kowar highlighted the percentage spilt between the stormwater

capital funds. Councilmember Stolzmann reminded the Committee, that Council gave direction to have the stormwater fund pay for only its fair share of this project. Based on this direction, Mr. Kowar stated that based on recent analysis that \$260,000 will be reallocated to the capital fund. The next project discussed was the street sweeper. Councilmember Stolzmann suggested a 100% allocation to the transportation fund as an option. The impacts of this reallocation were discussed and determined to be inappropriate. Mrs. Balser offered a 50/50 split between the two funds. Several additional options were discussed, however there was some uncertainty on the available funds in the transportation account. Mr. Kowar summarized that staff will evaluate the different options and bring a recommendation forward to the October 4th City Council Meeting. The direction of the Committee would have the priority of the Fleet Replacement Fund cover all qualifying costs and default to funding from the stormwater program.

Mr. Kowar asked if the Committee had any unanswered questions. The Committee was satisfied with the discussion and had no further questions at this time. Mr. Kowar stated that staff would report back on October 4th and 16th.

VIII. Adjourn

The meeting was adjourned at 4:45 pm by Mayor Muckle and seconded by Councilmember Stolzmann.

| Utility Committee Advanced Agenda | |
|-----------------------------------|---|
| DATE | ISSUE |
| 2019 | |
| 1/11 | Trash Bid Review Windy Gap CIP Update 4 th Quarter Financial Review (2018) |
| 3/8 | Water Supply Update (Begin Drought Strategy discussion if needed) Louisville Pipeline Report Windy Gap CIP Update Project Tour (SCWTP) |
| 5/10 | Preliminary 2020 Rates Cost of Service Water Supply Update (Drought Strategy if needed) Windy Gap CIP Update Water Engineering Update 1 st Quarter Financial Review (2019) |
| 7/12 | Draft 2020 Rates Instream Flow Update Windy Gap CIP Update |
| 9/13 | Final 2020 Rates Multi-family/Commercial Recycling Windy Gap CIP Update 2 nd Quarter Financial Review (2019) |

Utility Committee 2019 Utility Financial Plan Update

November 9, 2018

Overview

Financial Plan

- ▶ Performance Metrics
- ▶ Alternatives
 - ▶ Just-In-Time
 - ▶ Smoothing - Recommended by Staff and Utility Committee

Financial Planning Performance Metrics

Debt Service Coverage (DSC):

Ratio of net revenues

(operating revenue less operating expense)

to annual debt service payment

- ▶ **Target DCS above required minimum Values**
 - ▶ Conservative approach to ensure legal DSC minimums are met even if revenue forecasts are not achieved
 - ▶ Maintain or achieve higher credit ratings

Debt Service Coverage

Required DSC Ratio

| | |
|--|------|
| Colorado Water Resources and Power Development Authority | 1.10 |
| 2013 Water and Wastewater Enterprise Revenue Bonds | 1.15 |

Dual Target DSC Ratio

| Fund | w/o Tap Fees | with Tap Fees ⁽¹⁾ |
|------------|--------------|------------------------------|
| Water | 1.2 | 1.4 |
| Wastewater | 1.2 | 1.3 |
| Storm | 1.3 | 1.3 ⁽²⁾ |

(1) To reduce variability, tap fee revenue is from the prior year i.e. 2018 tap fee revenue was collected in 2017

(2) A tap fee for the stormwater utility has not been established, therefore the dual target is not used

Financial Planning Performance Metrics

(the same for all 3 Utilities)

Cash Reserves:

120 days cash or 33% of Total O&M

Working Capital Reserves Policy (section 2.4):

25% of current operating expenses

Rate Minimum:

Set to cover any increases in operating and maintenance costs

Debt Issuance

| Utility | Debt Service Payment (\$million) | | | | | | | |
|--------------|----------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| Water | \$0.9M | \$0.9M | \$0.9M | \$0.9M | \$0.9M | \$0.9M | \$0 | \$0 |
| Wastewater | \$1.3M | \$1.3M | \$1.3M | \$1.3M | \$1.3M | \$1.3M | \$2.0M | \$2.0M |
| Stormwater | \$0.3M | \$0.3M | \$0.3M | \$0.3M | \$0.3M | \$0.3M | \$0.4M | \$0.4M |
| Total | \$2.5M | \$2.5M | \$2.5M | \$2.5M | \$2.5M | \$2.5M | \$2.4M | \$2.4M |

Alternatives

Financial Model Inputs:

- ▶ Projected 2018 Year End Revenues and Expenditures from Financial System
- ▶ Tap Fees from 2018-2024 Revenue Projection (updated May/June '18 by Finance, Planning and Public Works)
- ▶ Capital Improvement Projects (updated October by Public Works, subject to year-end reporting)



WATER

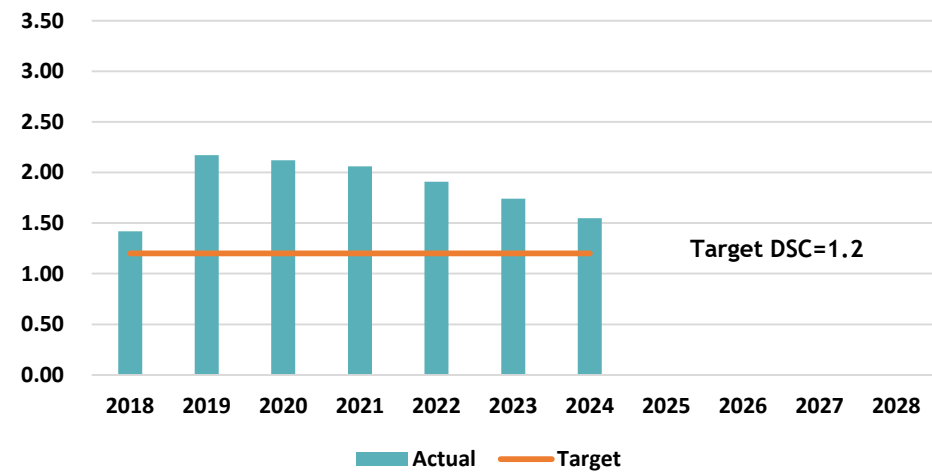
WATER

Financial Planning Alternatives

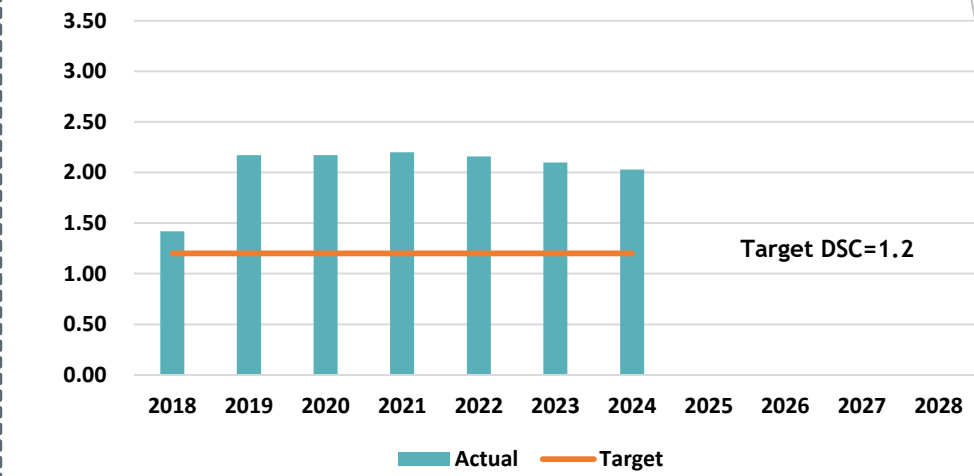
| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|----------------------------------|------|------|------|------|------|------|------|-------|------|
| 2018 Plan | | | | | | | | | |
| 3% | 3% | 3% | 3% | 3% | 3% | 0% | 0% | 0% | - |
| “Just-In-Time” Revenue Increases | | | | | | | | | |
| 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 20.9% | 0% |
| “Smoothing” Revenue Increases | | | | | | | | | |
| 0% | 1.2% | 1.6% | 1.7% | 1.8% | 1.8% | 1.8% | 1.9% | 1.9% | 1.9% |

WATER: Financial Plan Alternatives

Just-In-Time: DSC (0% for 2019)

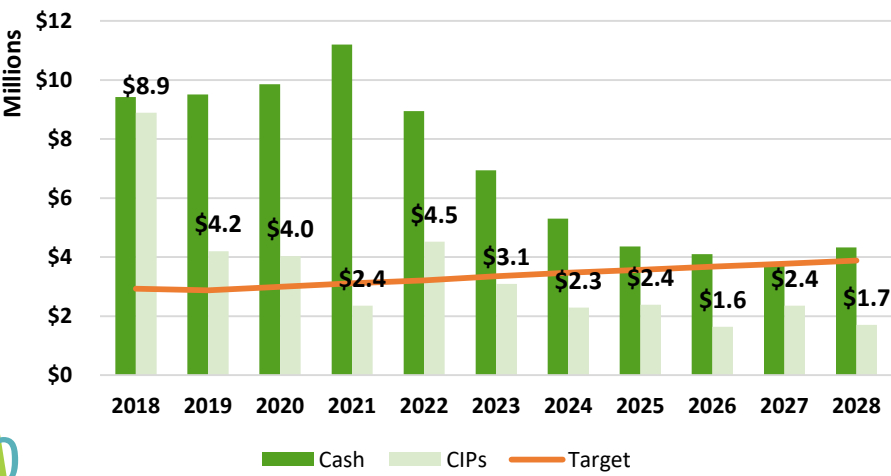


Smoothing: DSC (0% for 2019)

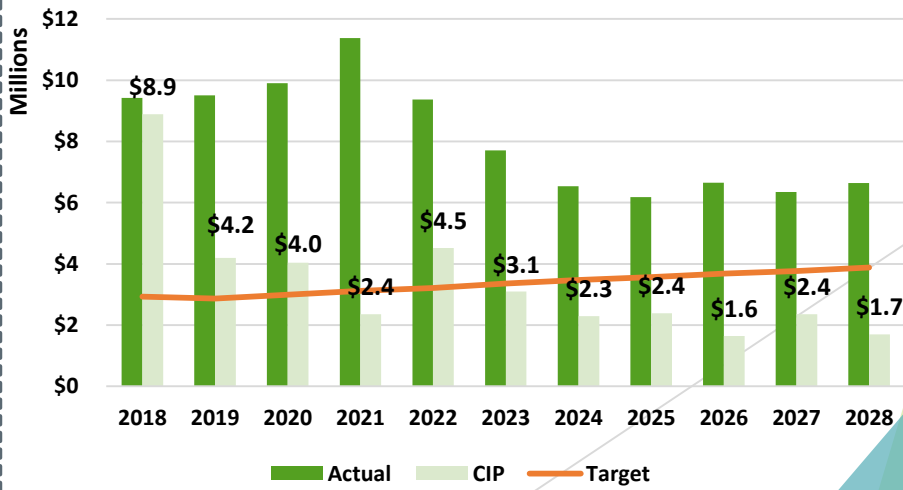


Recommended

Just-In-Time: Cash Reserves (0% for 2019)



Smoothing: Cash Reserves (0% for 2019)



WASTEWATER

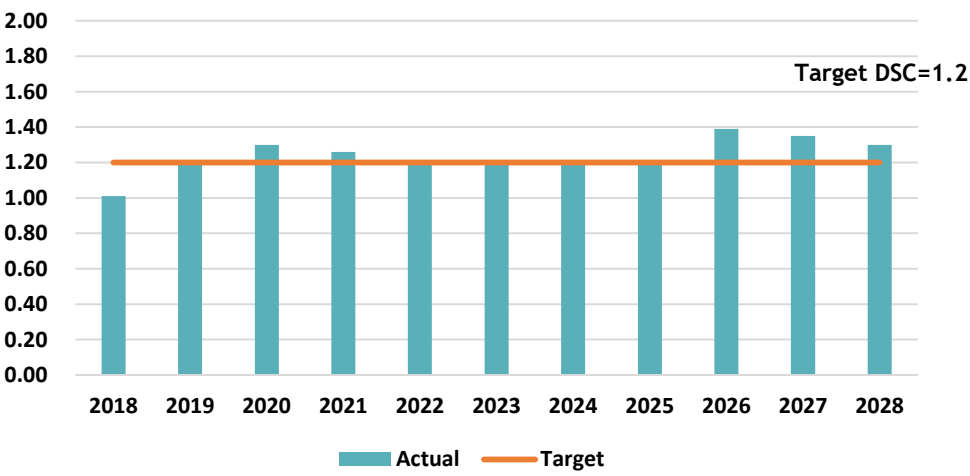
WASTEWATER

Financial Planning Alternatives

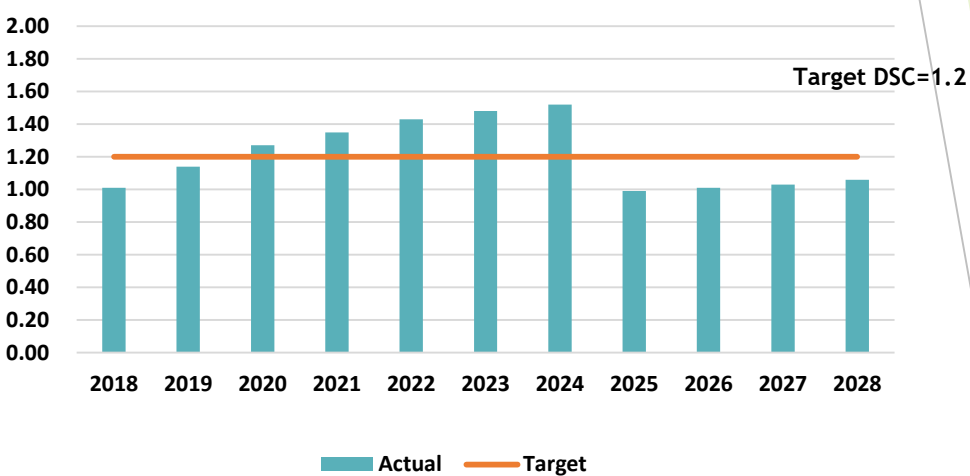
| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|----------------------------------|------|------|------|------|------|-------|------|------|------|
| 2018 Plan | | | | | | | | | |
| 7% | 7% | 7% | 7% | 7% | 7% | 6% | 0% | 0% | - |
| “Just-In-Time” Revenue Increases | | | | | | | | | |
| 10.8% | 0% | 0% | 0% | 3% | 2.1% | 35.6% | 0% | 0% | 0% |
| “Smoothing” Revenue Increases | | | | | | | | | |
| 7% | 4% | 4% | 4% | 3.5% | 3.1% | 3.1% | 3.1% | 3.2% | 3.2% |

WASTEWATER: Financial Plan Alternatives

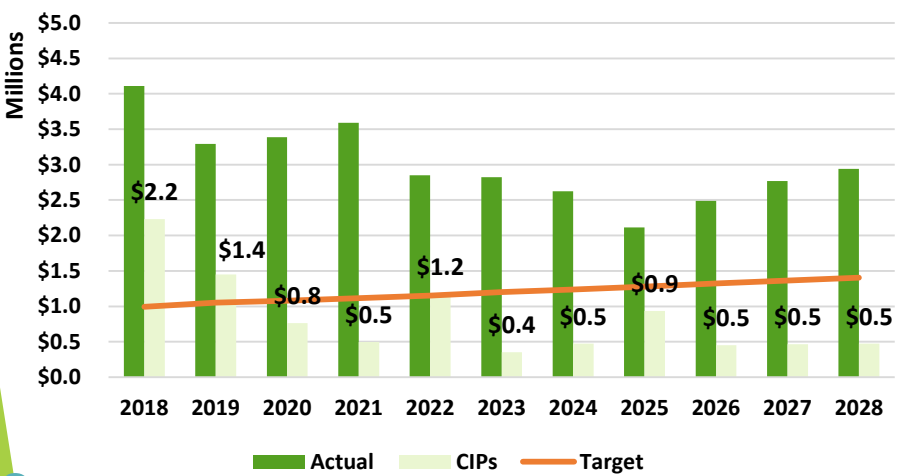
Just-In-Time: DSC (10.8% for 2019)



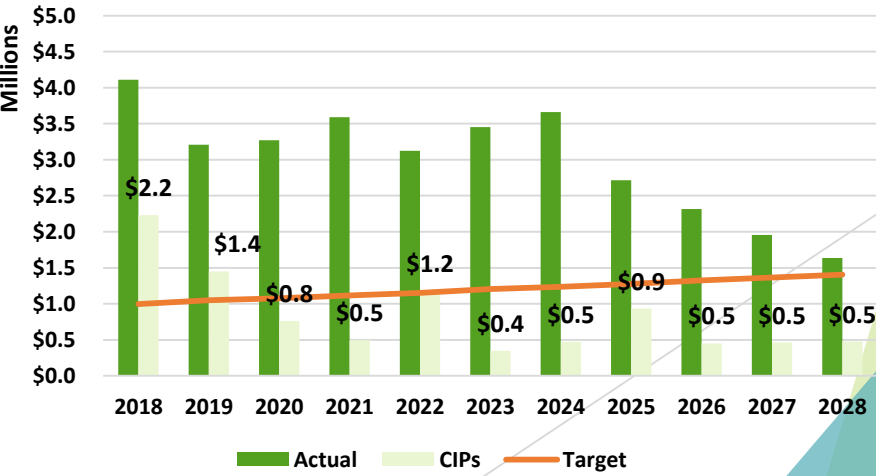
Smoothing: DSC (7% for 2019)



Just-In-Time: Cash Reserves (10.8% for 2019)



Smoothing: Cash Reserves (7% for 2019)



Recommended

STORMWATER

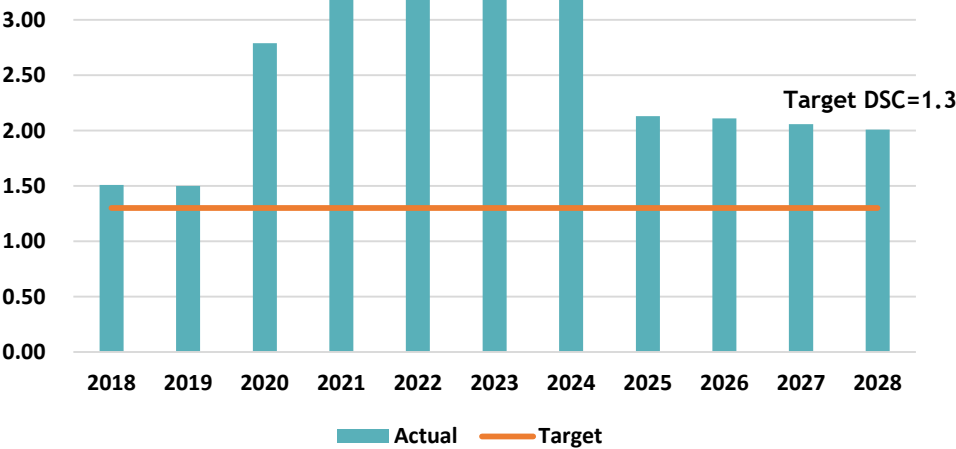
STORMWATER

Financial Planning Alternatives

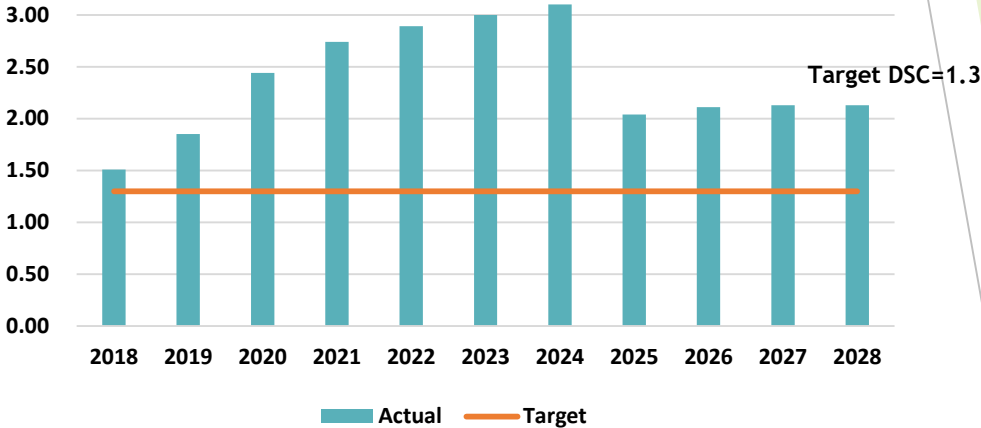
| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|----------------------------------|-------|------|------|------|------|------|------|------|------|
| 2018 Plan | | | | | | | | | |
| 7% | 4% | 4% | 4% | 4% | 0% | 0% | 0% | 0% | - |
| “Just-In-Time” Revenue Increases | | | | | | | | | |
| 0% | 68.4% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| “Smoothing” Revenue Increases | | | | | | | | | |
| 18.5% | 18.5% | 4% | 4% | 3% | 3% | 3% | 3% | 1.7% | 1.7% |

STORMWATER: Financial Plan Alternatives

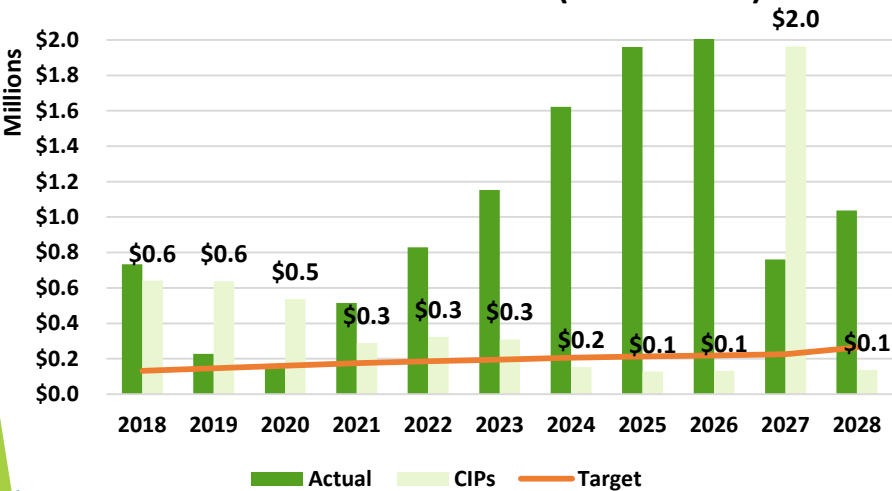
Just-In-Time: DSC (0% for 2019)



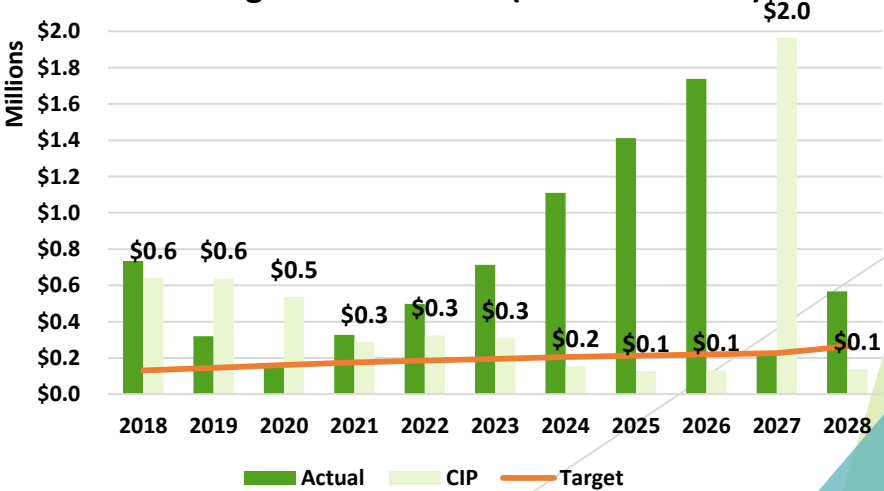
Smoothing: DSC (18.5% for 2019)



Just-In-Time: Cash Reserves (0% for 2019)



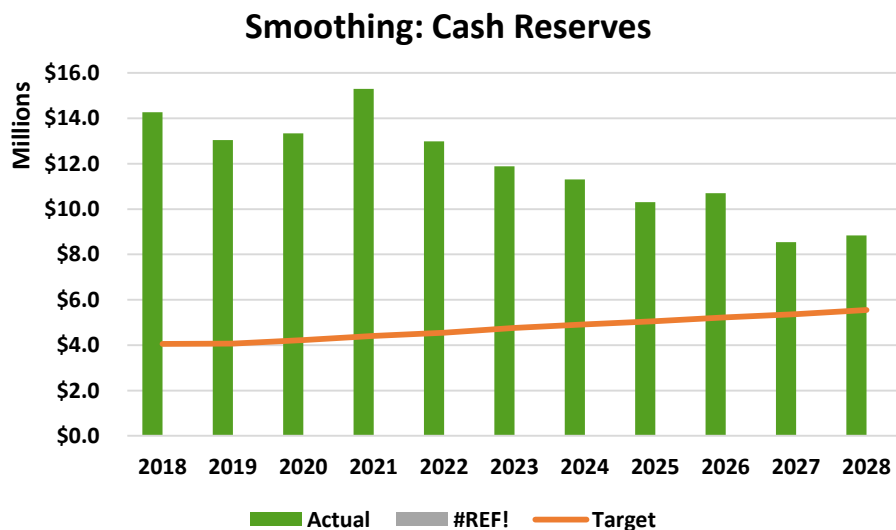
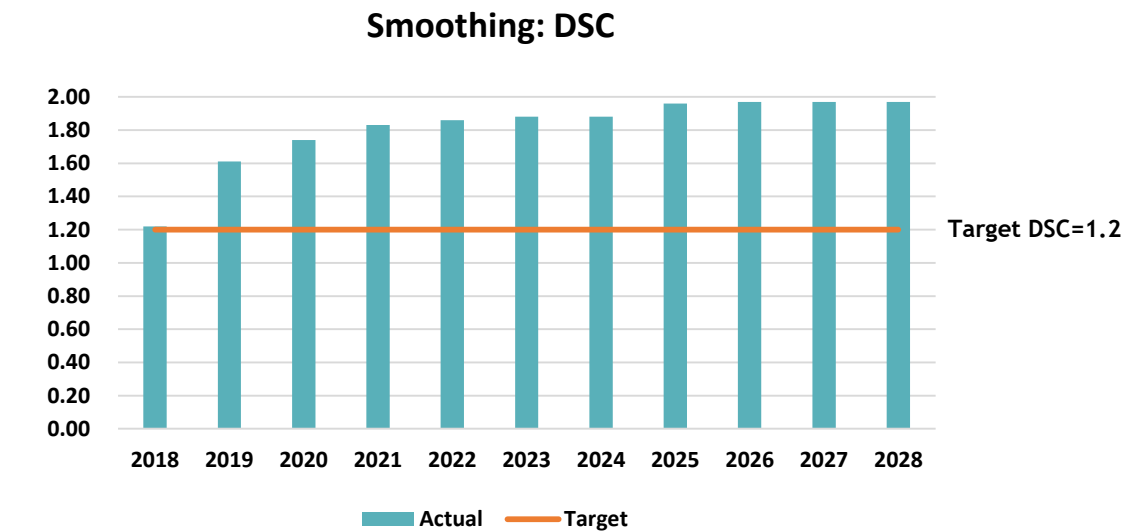
Smoothing: Cash Reserves (18.5% for 2019)



Recommended

COMBINED

Combined: Financial Plan Alternatives



Recommended Rate Increase:

| | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|--|----------------------|----------------------|----------------------|----------------------|----------------------|------|
| Alternative 2 - “Smoothing” Revenue Increases (All funds self-sufficient) | | | | | | |
| Water-O&M | 0.1% | 1.2% | 1.6% | 1.7% | 1.8% | 1.8% |
| Water-CIP | 0% | 0% | 0% | 0% | 0% | 0% |
| Water | 0% 3% | 1.2% 3% | 1.6% 3% | 1.7% 3% | 1.8% 2% | 1.8% |
| Waste-O&M | 3.1% | 1.3% | 1.4% | 1.4% | 1.4% | 1.4% |
| Waste-CIP | 3.9% | 2.7% | 2.6% | 2.6% | 2.1% | 1.7% |
| Wastewater | 7% 7% | 4% 7% | 4% 7% | 4% 7% | 3.5% 7% | 3.1% |
| Water-O&M | 2.6% | 0.6% | 0.8% | 0.8% | 0.8% | 0.8% |
| Water-CIP | 15.9% | 17.9% | 3.2% | 3.2% | 2.2% | 2.2% |
| Stormwater | 18.5% 7% | 18.5% 4% | 4% 4% | 4% 3% | 3% 4% | 3% |
| Total | 5.5% 5.5% | 4.5% 5.3% | 3.2% 5.3% | 3.3% 5.4% | 2.9% 5.4% | 2.6% |

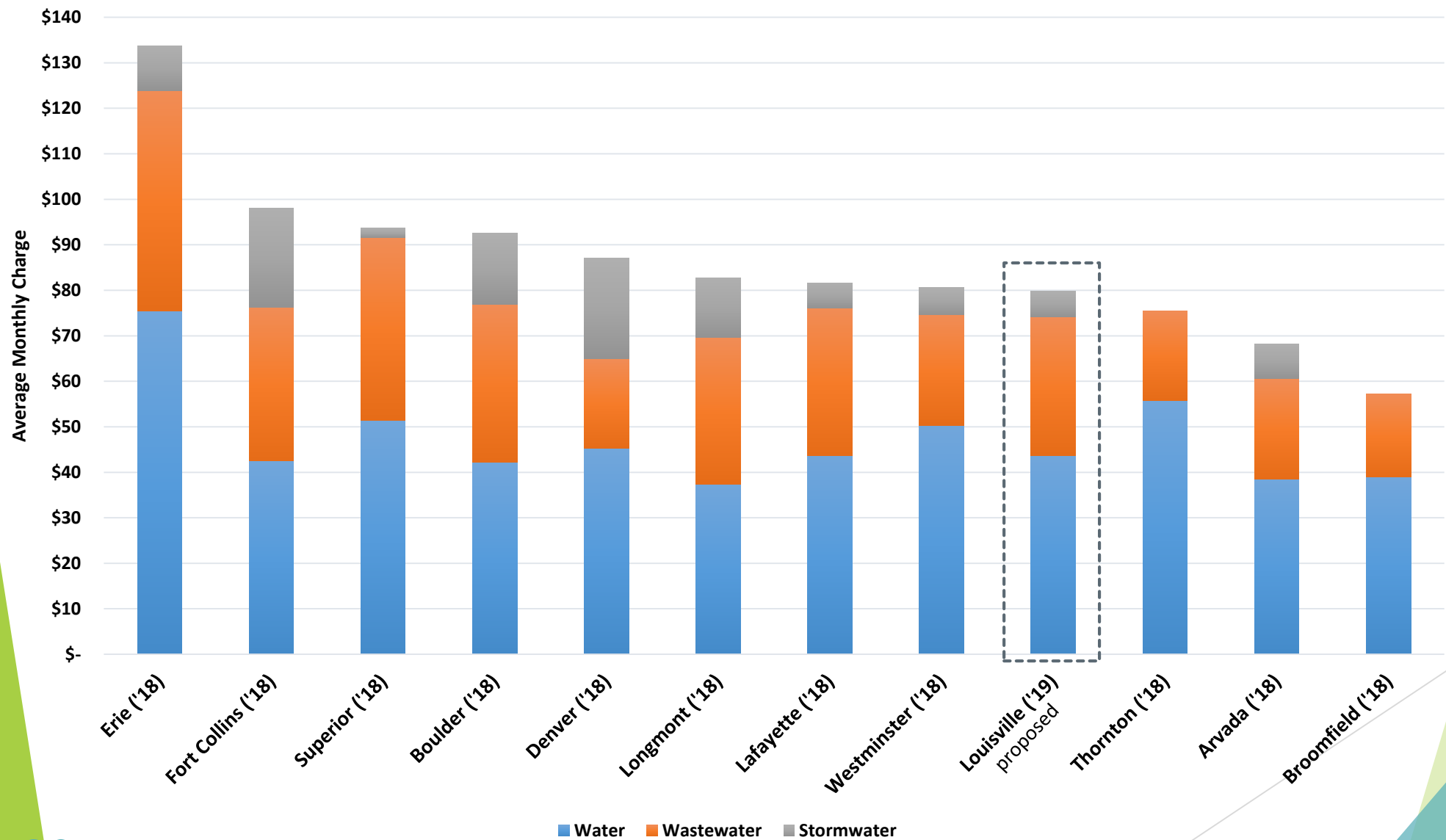
Prior Study 2019 - 2023 Projected Revenue Increases in strikethrough text

Average Monthly Residential Bill:

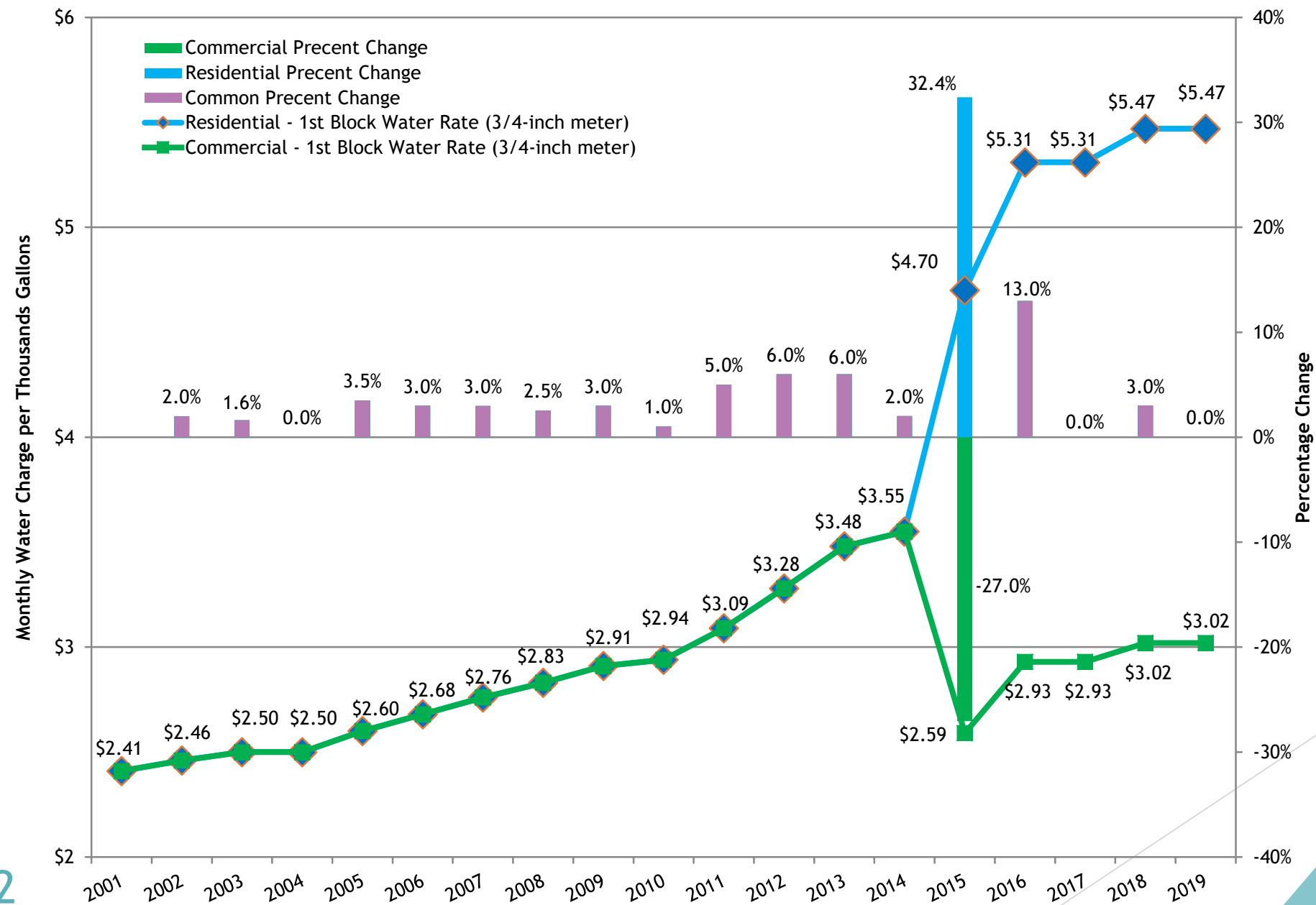
| | Current 2018 | Proposed 2019 | Difference | Percent Increase |
|------------|-------------------------|--------------------------|-------------------|-----------------------------|
| Water | \$43.65 | \$43.65 | \$0.00 | 0% |
| Wastewater | \$28.53 | \$30.55 | \$2.02 | 7% |
| Stormwater | \$4.71 | \$5.58 | \$0.87 | 18.5% |
| Total | \$76.89 | \$79.78 | \$2.89 | 3.8% |

Based on average usage of approx. 9,220 gallons. Actual bills will be dependent on usage and will vary based on seasonal fluctuation.

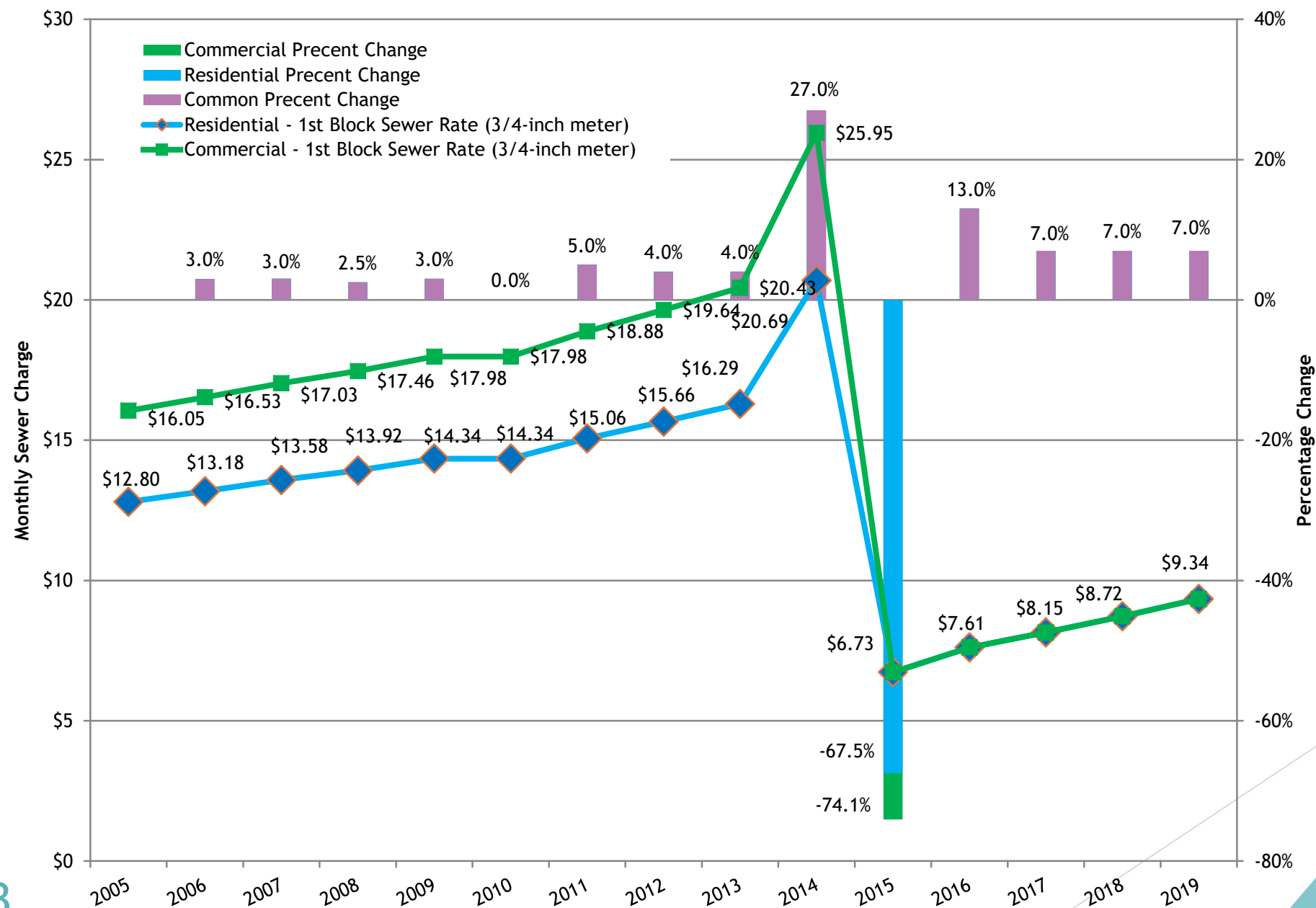
Average Monthly Water, Wastewater & Storm Rates (Louisville Single Family Residential)



Historical Water Rates



Historical Sewer Rates



Project Summary

| | Current - Nov-18 | | May-18 | | Jan-18 | | Oct-17 | | Aug-17 | |
|-------------|------------------|------------|----------|------------|----------|------------|----------|------------|----------|------------|
| | Projects | Percentage | Projects | Percentage | Projects | Percentage | Projects | Percentage | Projects | Percentage |
| Development | 0 | 0% | 0 | 0% | 0 | 0% | 1 | 1% | 80 | 77% |
| Bidding | 0 | 0% | 0 | 0% | 0 | 0% | 54 | 53% | 0 | 0% |
| Design | 2 | 2% | 2 | 2% | 2 | 2% | 2 | 2% | 0 | 0% |
| In progress | 1 | 1% | 26 | 25% | 79 | 77% | 25 | 25% | 10 | 10% |
| Removed | 6 | 6% | | | | | | | | |
| Completed | 95 | 93% | 76 | 75% | 23 | 23% | 22 | 22% | 14 | 13% |

Project Budget

| | |
|------------------------|-------------|
| Budget | \$1,575,000 |
| Current Expenditures | \$1,200,000 |
| Remaining | \$191,000 |
| Balance to be returned | \$184,000 |
| Removed Projects | \$100,000 |

HOWARD BERRY WATER TREATMENT PLANT (SOUTH)

| | | | Priority Ranking (1-10) | Status | Notes |
|------------------------------|--------------|---|-------------------------------|-------------|--------------------------------------|
| Location | Item | | | | |
| 1 | Pretreatment | Trac-vac Repair | 10 | Completed | |
| 2 | Pretreatment | New Raw Access Shed | 1 | Completed | |
| 3 | Pretreatment | Seal and Repair Concrete | 3 | Completed | |
| 4 | Pretreatment | Cherry Street Pipeline valve (CCGC) Replacement | 8 | Completed | |
| 5 | Pretreatment | Parking Lot Crack Seal and Patching | 2 | Completed | |
| 6 | Pretreatment | New Raw Water Bypass Valve | 7 | Completed | |
| 7 | Pretreatment | Lighting Improvements | 1 | Completed | |
| 8 | Pretreatment | Meter Testing / Calibration | 6 | Completed | |
| 9 | Pretreatment | Demo and Replace Surrounding Concrete (sidewalks) | 3 | Completed | |
| 10 | Pretreatment | Soda Ash Feeder Removal | 3 | Completed | |
| 11 | Pretreatment | Permanganate Feeder and Equipment Removal | 3 | Completed | |
| 12 | Pretreatment | Chemical Feed Electrical Boxes Removal | 3 | Completed | |
| 13 | Pretreatment | PH Meter Replacement | 7 | Completed | |
| 14 | Pretreatment | SCD Meter Replacement | 7 | Completed | |
| 15 | Pretreatment | Chemical Building Programmable Logic Controller (PLC) Removal | 2 | Completed | |
| 16 | Pretreatment | Obsolete Exterior Fire Alarm Relocate | 1 | Completed | |
| 17 | Pretreatment | DIOXIDE Lighting Replacement | 2 | Completed | |
| 18 | Pretreatment | Exterior Painting | 3 | Completed | |
| 19 | Pretreatment | Demo and Replace Surrounding Concrete (sidewalks and stairs) | 3 | Completed | |
| 20 | Pretreatment | Flocculator Replacement | 9 | Completed | |
| 21 | Main Bldg. | New Utility Sink | 1 | Completed | |
| 22 | Main Bldg. | Lighting Improvements | 3 | Completed | |
| 23 | Main Bldg. | VFD Electrical Panel Repair | 2 | Completed | |
| 24 | Main Bldg. | Filter Building Exhaust Fan Panel Replacement | 4 | Completed | |
| 25 | Main Bldg. | Old Trac-vac Filter Intake Removal | 2 | Completed | |
| 26 | Main Bldg. | MCC Concrete Pad Repair | 3 | Completed | |
| 27 | Main Bldg. | Sanitary Sump Pump Service and Maintenance | 7 | Completed | |
| 28 | Main Bldg. | Drywall Repairs | 1 | Completed | |
| 29 | Main Bldg. | Interior Finishes | 1 | In progress | New furniture this month |
| 30 | Main Bldg. | Window Tinting | 1 | Removed | Unavailable Product |
| 31 | Gallery | Surface Wash Pump Seal Replacement | 5 | Completed | |
| 32 | Gallery | Back Wash Pump Seals Replacement | 6 | Completed | |
| 33 | Gallery | Actuators Replacement | 9 | Completed | |
| 34 | Gallery | Filter to Waste Line Improvements | 8 | Completed | |
| 35 | Gallery | Filter 2 Sample Pump Repair | 7 | Completed | |
| 36 | Gallery | Air Blower Actuator Replacement | 6 | Completed | |
| 37 | Gallery | Electrical Panel Replacement | 5 | Completed | |
| 38 | Gallery | Clearwell Drain Improvements | 3 | Completed | |
| 39 | Gallery | Polymer Automation | 4 | Completed | |
| 40 | Gallery | Trac-vac Flow Meter Calibration and Improvement | 4 | Completed | |
| 41 | Gallery | Air Dyer Removal | 2 | Completed | |
| 42 | Gallery | Instrument Electrical Rail Repair | 5 | Completed | |
| 43 | Gallery | Chemical Feed (chlorine gas & caustic) Relocation | 4 | Completed | |
| 44 | Gallery | Backwash Rate Pump control valve | 6 | Completed | |
| Engineering Support Services | | | | Design | Finishing as-builts and SCADA tie in |

SID COPELAND WATER TREATMENT PLANT (NORTH)

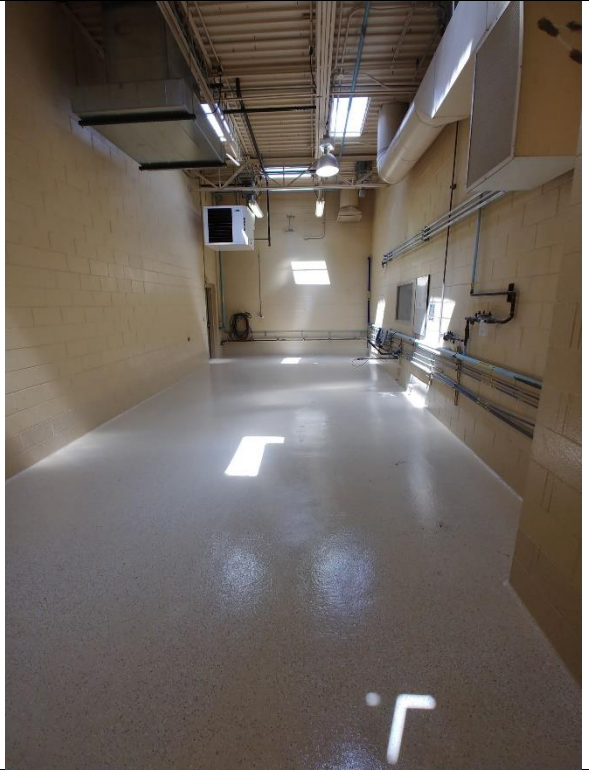
| | Location | Item | Priority Ranking (1-10) | Status | Anticipated Completion Date |
|----|---------------------|--|-------------------------|-----------|--|
| 1 | Raw | Louisville Reservoir Aerators Compressors and Diffusers Repair | 7 | Completed | |
| 2 | Raw | Louisville Reservoir Aerator Expansion | 3 | Completed | |
| 3 | Raw | Inflow Measurement Device Replacement | 6 | Completed | |
| 4 | Raw | Raw Flow Meter Replacement | 4 | Completed | |
| 5 | Raw | Northern Vault Improvements | 4 | Completed | |
| 6 | Raw | Algae Monitoring System | 5 | Completed | |
| 7 | Pretreatment | ACH Sump Pump Holding Tank | 6 | Completed | |
| 8 | Pretreatment | Streaming Current Detector Electrical Panel Replacement | 2 | Completed | |
| 9 | Pretreatment | Secondary Containment Installation | 6 | Completed | |
| 10 | Pretreatment | Equipment Storage | 1 | Completed | |
| 11 | Pretreatment | PLC Cabinet Replacement | 3 | Completed | |
| 12 | Pretreatment | Roof Repairs | 5 | Removed | Addressed with hail damage |
| 13 | Transition to Basin | Trac-vac Flow Meter Replacement | 4 | Completed | |
| 14 | Transition to Basin | Trac-vac Vault Improvements (improve access and ventilation) | 3 | Completed | |
| 15 | Transition to Basin | Recycle Flow Meter Replacement | 5 | Completed | |
| 16 | Transition to Basin | Recycle Vault Improvements (improve access and ventilation) | 3 | Completed | |
| 17 | Transition to Basin | SCD Vault Improvements (improve access and ventilation) | 3 | Completed | |
| 18 | Sed Basin | Raw Vault Low Flow Controls Calibration | 7 | Completed | |
| 19 | Sed Basin | Lighting Improvements | 4 | Completed | |
| 20 | Sed Basin | Rapid Mixer Propellers and Shafts Replacement | 8 | Completed | |
| 21 | Sed Basin | Demo and Replace Surrounding Concrete (sidewalks) | 3 | Completed | |
| 22 | Sed Basin | Rapid Mixer Electrical Panel Replacement | 5 | Completed | |
| 23 | Sed Basin | Broken Conduit Repair | 4 | Completed | |
| 24 | Sed Basin | Raw Vault Improvements (improve access and ventilation) | 3 | Completed | |
| 25 | Sed Basin | Flocculators Electrical Panel Replacement | 5 | Completed | |
| 26 | Sed Basin | Sed Basin Level Transmitters (2) Replacement | 6 | Completed | |
| 27 | Electrical Room | Transformer Maintenance | 9 | Completed | |
| 28 | Electrical Room | Demo and Replace Surrounding Concrete (sidewalks) | 3 | Completed | |
| 29 | Electrical Room | Backup Generator Evaluation | 8 | Completed | |
| 30 | Chlorine Dioxide | PVC Pipping Repair | 5 | Completed | |
| 31 | Chlorine Dioxide | Demo and Replace Surrounding Concrete (sidewalks) | 3 | Completed | |
| 32 | Chlorine Dioxide | Epoxy Paint Floor | 2 | Completed | |
| 33 | Chlorine Dioxide | Lighting Improvements | 2 | Completed | |
| 34 | Chlorine | Equipment storage (ladder hangers) | 1 | Completed | |
| 35 | Chlorine | Lighting Improvements | 2 | Completed | |
| 36 | Chlorine | Chemical Flow Adjustment Valve Replacement | 3 | Completed | |
| 37 | Chemical Room | Sodium Chlorite Level Sensor SCADA Tie-In | 4 | Completed | |
| 38 | Chemical Room | Secondary Containment for Chemical Tanks | 6 | Removed | Higher cost - Included in future CIP |
| 39 | Chemical Room | Silicate Tank Replacement | 6 | Removed | Higher cost - Included in future CIP |
| 40 | Chemical Room | Chlorine Detector | 5 | Removed | Chlorine System is being removed |
| 41 | Main Building | Relocate Network Switch | 4 | Removed | Delayed to be included in a future CIP |
| 42 | Main Building | Automate Polymer Mixing | 3 | Completed | |
| 43 | Filter | Filter Flow Meter Calibrations | 3 | Completed | |
| 44 | Filter | #2 Filter Backwash Valve Calibration | 3 | Completed | |
| 45 | Filter | Pre-Inline Chlorine Probe Installation | 4 | Completed | |
| 46 | Filter | Filter To Waste Valve/Flow Meter Automation | 4 | Completed | |
| 47 | Filter | Link Seals Replacement | 4 | Completed | |
| 48 | Filter | Backwash Turbidity SCADA Conductivity | 4 | Completed | |
| 49 | Backwash Building | Epoxy and Seal Walls | 2 | Completed | |
| 50 | Backwash Building | VFD Electrical Panel Replacement | 5 | Completed | |
| 51 | Backwash Building | Recycle Tank Level Sensor Replacement | 5 | Completed | |
| 52 | Backwash Building | Lighting Improvements | 2 | Completed | |
| 53 | Backwash Building | Vault Improvements (improve access and ventilation) | 3 | Completed | |
| 54 | 3 MG Tank | Level Transmitter Replacement | 5 | Completed | |
| 55 | 3 MG Tank | Tank Outflow Vault Replacement | 3 | Completed | |
| 56 | 3 MG Tank | Electrical Conduit Repair and Replacement | 5 | Completed | |
| 57 | Lower Pond | Low Zone Vault Improvements (improve access and ventilation) | 3 | Completed | |
| 58 | Exterior | Perimeter Fence Repair | 3 | Completed | |
| | | Engineering Support Services | | Design | Finishing as-builts and SCADA tie in |

HBWTP - Chorine Room

BEFORE

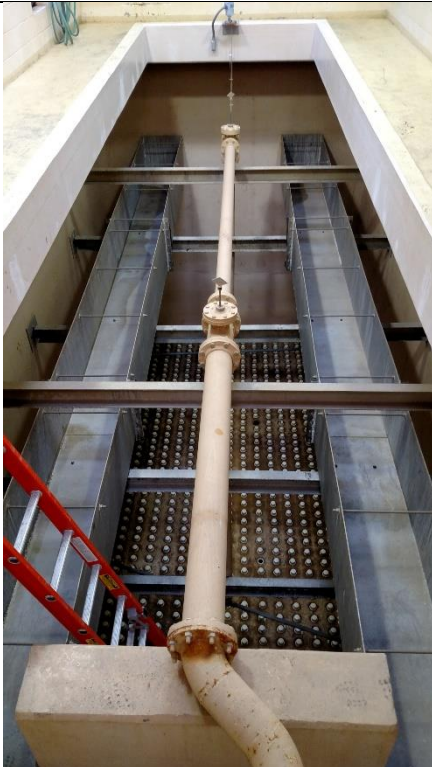


AFTER



HBWTP – Filter Media

BEFORE



AFTER



HBWTP – Sedimentation Basins

BEFORE



AFTER



HBWTP – Pipe Gallery

BEFORE



AFTER



U.S. Drought Monitor Colorado

October 23, 2018

(Released Thursday, Oct. 25, 2018)

Valid 8 a.m. EDT

Drought Conditions (Percent Area)

| | None | D0-D4 | D1-D4 | D2-D4 | D3-D4 | D4 |
|---|-------|-------|-------|-------|-------|-------|
| Current | 16.64 | 83.36 | 67.83 | 59.23 | 39.09 | 13.64 |
| Last Week 10-16-2018 | 16.64 | 83.36 | 67.83 | 59.23 | 39.09 | 13.64 |
| 3 Months Ago 07-24-2018 | 17.85 | 82.15 | 76.64 | 60.82 | 39.72 | 10.20 |
| Start of Calendar Year 01-02-2018 | 6.57 | 93.43 | 33.53 | 7.27 | 0.00 | 0.00 |
| Start of Water Year 09-25-2018 | 14.19 | 85.81 | 72.30 | 64.41 | 48.47 | 16.21 |
| One Year Ago 10-24-2017 | 71.57 | 28.43 | 1.12 | 0.00 | 0.00 | 0.00 |

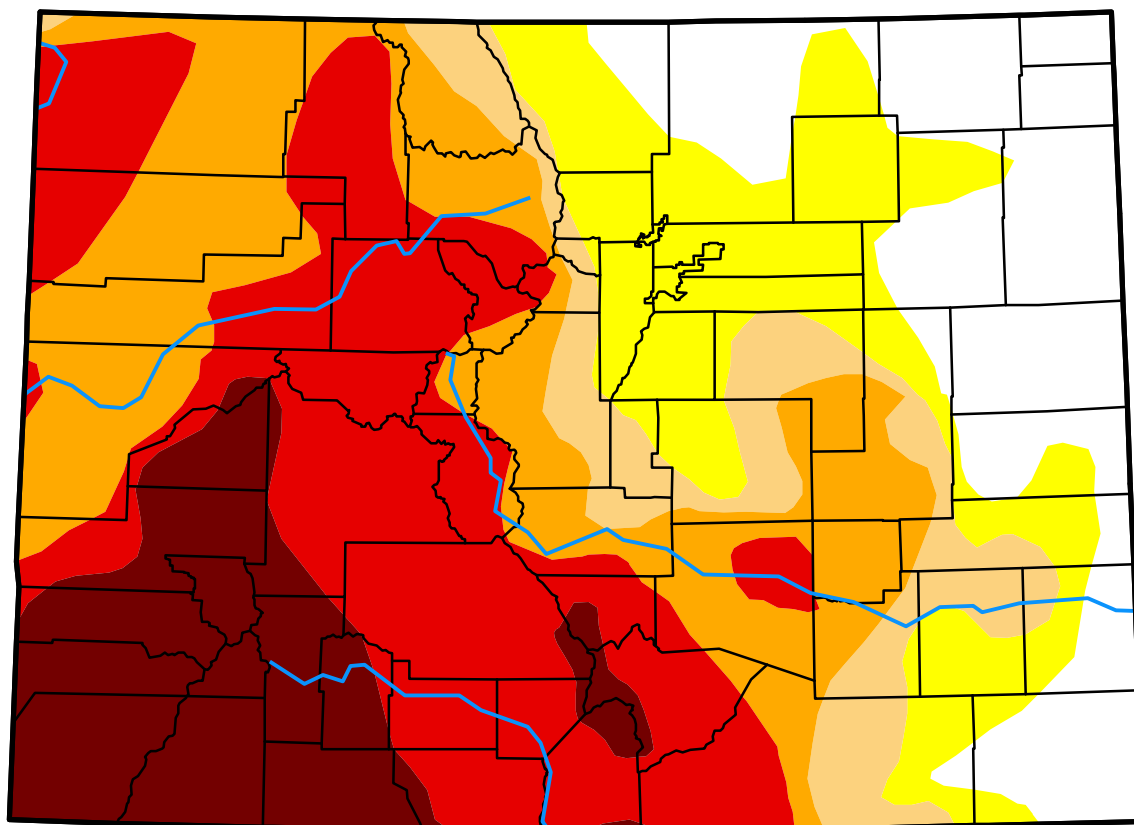
Intensity:

| | |
|--|---|
|  D0 Abnormally Dry |  D3 Extreme Drought |
|  D1 Moderate Drought |  D4 Exceptional Drought |
|  D2 Severe Drought | |

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:

Eric Luebehusen
U.S. Department of Agriculture





Municipal Water Management Plan

City of Louisville, Colorado

October 2016



Municipal Water Management Plan

For the City of Louisville, Colorado

Prepared by



*In Collaboration with
Spronk Water Engineers, Inc*

October 2016

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Attachments

1. South Boulder Creek Straightline Map
2. Louisville Firm Yield Scenarios Graph
3. Possible Buildout Demands Graph

INTRODUCTION

This Water Management Plan (“Plan”) is recognized as part of the City of Louisville’s (“City”) continuing long range water resource planning process. The Plan’s purpose is to keep the planning process updated using current water related data. Aspects and updates related to the City’s databases, operation and management goals and general water-related policies adopted in this report are consistent with other recently available City documents, most notably the Comprehensive Plan. Additionally, this Plan is also recognized as a continuation of previous “Raw Water Master Plans” prepared for the City in 1992, 1998, and 2003. This previous planning and foresight has resulted in the development of varied water resources sufficient to supply the City’s current water needs through drought periods.

The purpose of this report, however, varies in context from previous studies with regard to the following topics: water supply operations, historical trends, drought management planning, climate change implications, and future water acquisitions. The basis of this difference is found in the report’s structure to provide practical alternatives for each of these components, rather than solely identifying technical results. This report also includes the additional consideration that such alternatives will need to be reviewed and modified on a regular basis, especially as further hydrological information becomes available.

This report is categorized into the five sections mentioned above. The overall methodology used in developing the report was to initially establish a comprehensive scientific database using the study period of 2003-2015, and adding to the previous City Raw Water Master Plan database (1950 - 2002). Data from the previous Raw Water Management Plan was updated through 2015. Subsequently, the updated database provided the necessary information to perform the other analyses described within this report. The other categories were identified and selected because of their importance in providing the City’s staff the necessary information to proceed with its water resource project planning, budget development, city-wide water operations enhancements, and proposed water right acquisitions.

This report also provides practical City-wide alternatives to improve overall efficiency and maximize Louisville’s annual water supplies. These comments are based on Resource Based International’s (“RBI”) past five years of administering the City’s water rights and, recognizing operational constraints. This practical approach precluded the need to do City-wide operational modeling. This report does address areas of management that may require further modeling efforts, but these future efforts need to be strategic in purpose and address only a few operational scenarios rather than reexamine the entire City-wide operations.

A new addition to the City’s water resource planning is the evaluation of potential climate change impacts on the City’s water rights and raw water operations. Climate change impacts were evaluated using the results of previous regional climate studies to project potential effects on Louisville’s water operations and infrastructure. The purpose of the climate change evaluation was to: (1) focus on possible changes related to the City’s water supplies and demands; (2) determine climate change effects on the City’s current drought management strategies; and (3) adjust the City’s long term water supply planning to adapt to climate change effects.

The report concludes with a summary of the study’s findings and a list of alternatives for continuing to optimize the City’s water resources. RBI recommends updating or supplementing this report as needed based on further information.

LOUISVILLE'S WATER SUPPLY SYSTEM OPERATIONS

The City of Louisville's water supply system is supplied with diversions from South Boulder Creek through two diversion structures: the Louisville Pipeline and the Community Ditch. South Boulder Creek diversions can be conveyed directly to the City's water treatment plants - Sid Copeland Water Treatment Plant ("SCWTP") and the Howard Berry Water Treatment Plant ("HBWTP") – or stored for later use in the City's storage facilities. The City's water system is supplemented with deliveries of water from the Colorado Big Thompson Project via a pipeline to the SCWTP. Future deliveries from the Windy Gap Firming Project will also supplement the City's water supply. A map of the City's water supply is attached as Figure 1.

The following discussion provides a background description of the City's raw water supply systems/operations and identifies the existing constraints within the system.

Water Supplies

South Boulder Creek Water Rights

Diversions

Louisville has forty-four combined direct flow and storage water rights, from thirteen ditch companies that are administered on a daily basis on South Boulder Creek. The majority of Louisville's water rights are direct flow rights that are available only during the irrigation season (April through October) and can be used for direct use at the treatment plants, or stored in Harper, Louisville, or Marshall Reservoirs. Louisville also has storage water rights, which are available only in the non-irrigation season (November – March), that are typically diverted at the Louisville Pipeline and stored in Louisville or Harper Reservoirs until the following spring. To the extent possible, Louisville historically stored this water prior to delivery to the treatments plants to obtain the highest possible level of water quality.



South Boulder Creek

Water rights are administered on hydrological and legal considerations by the State of Colorado and are allocated pursuant to the Prior Appropriation Doctrine: first in time, first in use. Water rights are characterized as having "senior" to "junior" status; in times of water shortage, senior rights are allowed to divert their full entitlement water before any junior rights are allowed to divert. The City operates its water rights on a daily basis depending on: (1) water availability in South Boulder Creek; (2) legal and administrative constraints associated with each right; (3) delivery rate limits related to pipelines and treatment capacities; and (4) daily City water demands. The City's most senior rights are available in all years, whereas the junior rights typically are available in only average to above average runoff years (Table 1). Operations and diversions are also determined by the City's daily municipal water demands and the delivery system capacities of the treatment plants.

Table 1
Summary of Louisville's Direct Flow Water Rights

| | NAME | CASE | PRIORITY | | | START DATE | | END DATE | |
|---------------|------------------------|-----------------|----------|-----|------|------------|-----|----------|-----|
| | | | MON | DAY | YR | MO | DAY | MON | DAY |
| Senior Rights | HOWARD DIVERSION | (W-8500-77) | 4 | 1 | 1850 | 4 | 1 | 10 | 31 |
| | HOWARD CU | (W-8500-77) | 4 | 1 | 1860 | 4 | 1 | 10 | 31 |
| | HOWARD CU 2 | 99CW230 | 4 | 1 | 1860 | 4 | 1 | 10 | 31 |
| | HOWARD .65 | (21299) | 4 | 1 | 1860 | 4 | 2 | 10 | 30 |
| | HOWARD | (10904 & 12698) | 4 | 1 | 1860 | 4 | 1 | 10 | 31 |
| | McGINN DITCH | 87-CW-327 | 5 | 1 | 1860 | 4 | 1 | 10 | 31 |
| | EAST BOULDER | (82CW305) | 4 | 1 | 1862 | 4 | 1 | 10 | 31 |
| | COTTONWOOD #2 | (W-9193-78) | 4 | 15 | 1863 | 5 | 1 | 8 | 31 |
| | COTTONWOOD No. 2 | 99CW230 | 4 | 15 | 1863 | 5 | 1 | 8 | 31 |
| Mixed Rights | DRY CREEK DAVIDSON | (12698) | 5 | 1 | 1863 | 4 | 1 | 10 | 31 |
| | DRY CREEK #2 | (21299) | 5 | 1 | 1864 | 4 | 2 | 10 | 30 |
| | DRY CREEK NO. 2 | (W-8500-77) | 5 | 1 | 1864 | 4 | 15 | 10 | 1 |
| | DRY CREEK No. 2 CU | 99CW230 | 5 | 1 | 1864 | 4 | 15 | 10 | 1 |
| | ENTERPRISE | (21299) | 2 | 1 | 1865 | 4 | 2 | 10 | 30 |
| | ENTERPRISE | (82-CW-305) | 2 | 1 | 1865 | 4 | 15 | 9 | 15 |
| | LEYNER COTTONWOOD S | 87-CW-327 | 4 | 1 | 1865 | 4 | 15 | 9 | 15 |
| | McGINN DITCH | 87-CW-327 | 6 | 1 | 1865 | 4 | 25 | 8 | 31 |
| | MARSHALLVILLE DITCH | 87-CW-327 | 6 | 1 | 1865 | 4 | 25 | 8 | 31 |
| | LEYNER COTTONWOOD M | 87-CW-327 | 4 | 1 | 1866 | 4 | 15 | 9 | 15 |
| | LEYNER COTTONWOOD J | 87-CW-327 | 10 | 1 | 1870 | 4 | 11 | 9 | 24 |
| Junior Rights | DAVIDSON DITCH | (83-CW-319) | 4 | 15 | 1872 | 4 | 25 | 8 | 31 |
| | S BOULDER & COAL CREEK | (21299) | 6 | 1 | 1872 | 4 | 2 | 10 | 30 |
| | S.B.C.C. (DIRECT) | | 6 | 1 | 1872 | 5 | 1 | 8 | 31 |
| | GOODHUE DITCH | (83-CW-319) | 5 | 1 | 1873 | 4 | 25 | 8 | 31 |
| | MARSHALLVILLE DITCH | 87-CW-327 | 6 | 30 | 1878 | 5 | 15 | 7 | 12 |
| | COMMUNITY DIRECT | | 6 | 6 | 1885 | 5 | 1 | 7 | 25 |
| | LOUIS. PIPELINE | (83CW318) | 6 | 18 | 1983 | 11 | 1 | 10 | 31 |
| | GOLF COURSE DIRECT | 88-CW-172 | 9 | 20 | 1988 | 11 | 1 | 10 | 31 |

South Boulder Creek water rights are generally categorized into three groups: Marshall Lake shares; South Boulder and Coal Creek Ditch shares; and all other South Boulder Creek water rights

- *Marshall Lake Shares* – Marshall Lake is owned and operated by Farmers Reservoir and Irrigation Company (“FRICO”). FRICO diverts water from South Boulder Creek under a number of winter storage rights for the benefit of their shareholders. At the end of the winter storage season, FRICO allocates the water in storage at Marshall Lake to its shareholders. The City receives a pro-rata portion of the allocation which becomes available for use in the City’s water system. The primary Marshall Lake storage rights are senior to all other winter storage rights on the South Boulder Creek and the South Platte.

The Marshall Lake summer direct flow rights are generally available to divert during May 15 - July 15. Marshall Lake direct flow rights yield water to the City in average to above average streamflow years. As a result, these direct rights do not contribute to dry-year supplies (“firm yield”) unless they were stored the previous year.

- *South Boulder and Coal Creek Ditch Shares (“SBCC”)* - The SBCC ditch originally had its own headgate on South Boulder Creek. In 1940, after a flood, the ditch company legally changed the

point of diversion location downstream to the Community Ditch. Accordingly, the South Boulder and Coal Creek Ditch currently delivers water diverted, pursuant to its decrees, to company's shareholders via the Community Ditch and through Marshall Lake. Louisville is the majority owner of SBCC shares which consist of direct flow and storage rights.

- *Other South Boulder Creek Water ("Other SBC")* - All other water diverted from South Boulder Creek that is not associated with the Marshall Lake or SBCC shares is referred to Other South Boulder Creek Water. When this water is diverted through FRICO facilities, Community Ditch and Marshall Lake, it is referred to as Foreign Water. Other SBC water is comprised of both direct flow and storage water rights. The direct flow rights were originally irrigation rights but have subsequently been acquired and transferred through water court by the City for municipal use. This category of water rights constitutes 36 of the 44 South Boulder Creek water rights owned by Louisville. These supplies include a range of senior to junior water rights, with the majority of the rights available during May-June each year. All of these rights are decreed for diversion at the Community Ditch, the Louisville Pipeline, or both.

Return Flow Obligations

Many of the transferred water rights (from agricultural to municipal use) purchased by the City have two components: consumptive use credits and return flow obligations. The consumptive use credit is that portion of the water right that was historically consumed by the crop; the return flow obligation is that portion that represents surface and groundwater runoff resulting from historical irrigation practices. The City is entitled to use its entire share of consumptive use credits but must replace the return flow component back to stream system.

Return flow obligations usually represent about 20-25% of the water diverted from South Boulder Creek with some variability based on individual water rights. Some water rights have a higher percentage than others while many of the older water right transfer cases decreed by the City did not have any return flow component. Further, return flow obligations are separated into surface return flows and groundwater return flows. Surface return flows are returned to South Boulder Creek at the time the specific water right is diverted; groundwater return flows are lagged to simulate the historical groundwater travel time to reach the creek. Lagged groundwater return flow obligations are returned as specified in the various water right decrees.

City Reuse Potential

Only Marshall Lake shares and SBCC rights can be utilized by the City for reuse under current conditions; these rights have specified reuse terms in their decrees allowing the City to 'recycle' the water and send it to the City's reuse water system. This water is defined as reusable water and these "credits" are available to the City for other uses, including replacing return flow obligations discharged from the wastewater treatment plant. All other South Boulder Creek water rights with potential return flow credits require future water court action for reuse approval. Windy Gap Firming water, outlined below, will also be reusable within the City's system once available.

A prior analysis was performed by RBI to determine the of amount reuse water that was available during a study period of 2004-2014. The results indicated that Louisville annually averages approximately

1,100 acre-feet ("AF") of reusable water. Historically, replacing the required daily return flow requirements was the first priority for which this reusable water was used.



Coal Creek Golf Course

The second use of reusable credits is supplemental irrigation supplies at the Coal Creek Golf Course ("golf course") and City parks. Historically, when excess reusable water was available, the golf course and parks received deliveries from July-October.

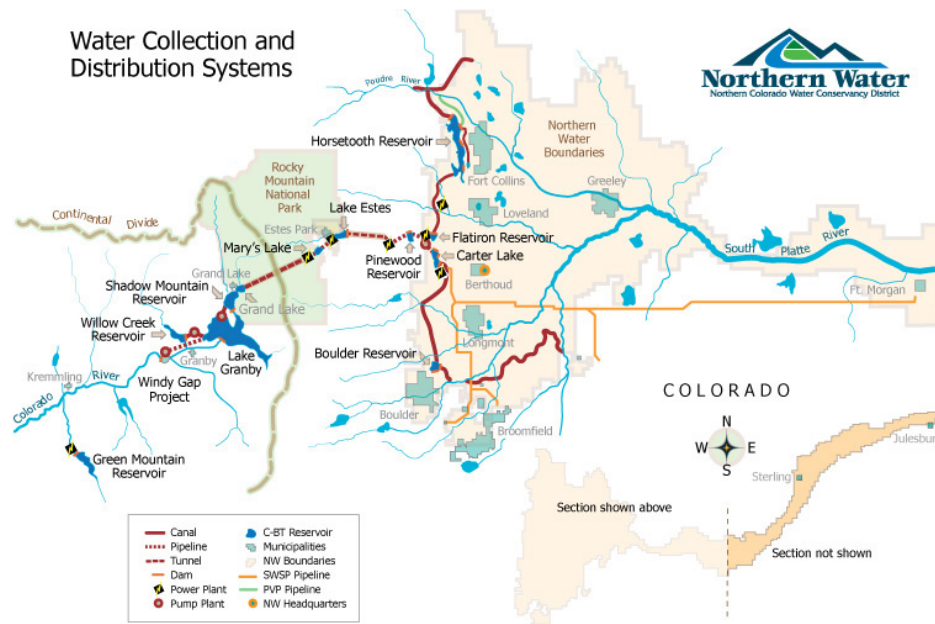
Study results indicate that while there is sufficient reusable water supplies in average and above average years for use in the City, reusable supplies are available in amounts only sufficient to meet return flow obligations after the first year of a drought. During the second year of a

drought, the City's return flow obligations dominate the use of the reusable water. As the

City seeks to refill Marshall Reservoir as expediently as possible, increased diversions magnify the return flow obligations that are typically spread over the entire diversion season. As a result of these increased return flow obligations incurred while filling Marshall Reservoir, no reuse water is available to supply water for any other uses. Further, because reuse supplies and return flow obligations are essentially the same during droughts, reuse water does not contribute to the City's firm yield supplies.

Colorado – Big Thompson Units (C-BT)

A significant supplemental supply source for the City are C-BT units that are derived from the Northern Colorado Water Conservancy District ("NCWCD") storage and delivery system. The C-BT system collects water from the Colorado River headwaters, on the West Slope, and diverts it through a series of tunnels to the Eastern Slope. C-BT water (and future Windy Gap water) is then delivered to the City via the Southern Water Supply Project ("SWSP") pipeline. C-BT units have been considered a primary option for meeting future demands and drought protection (C-BT's source of supply is located on the west slope). Purchase and use of C-BT units are not subject to the usually required water court transaction associated with South Boulder Creek rights. C-BT units are legally available for municipal use at the time of purchase, thereby making these units a viable water source for the future. Louisville owns 2,067 C-BT units which yield an average of 0.70 AF/unit of water annually. C-BT units are comprised of "one-time" use water only, and therefore, cannot be reused within the City's system.



C-BT System

Windy Gap Firing Project (Windy Gap Firing)

The Windy Gap Firing Project is an ongoing project of the Northern Water Municipal Subdistrict to divert and store west slope water supplies in the yet-to-be-built eastern slope storage - Chimney Hollow Reservoir.

Windy Gap Firing Project supplies have also been considered a viable water source for the same reasons as C-BT units. However, for planning purposes, Windy Gap Firing water has been considered drought protection rather than an average year water supply, based on costs and operations. Windy Gap Firing water rights are subject to transaction constraints similar to C-BT units. Further, Windy Gap Firing's west slope rights are junior and can be diverted to east slope reservoirs only during times of water and storage availability on the west slope. As a result, and until such time Chimney Hollow Reservoir is constructed, the junior priority of the Windy Gap Firing water rights does not provide a significant benefit to the City (Louisville has not utilized Windy Gap water supplies).



Windy Gap Reservoir – Northern Water

Upon completion of the reservoir, the Windy Gap Firing Project will divert water from the West Slope in times of sufficient supply, store the water in the newly completed reservoir, and then release this water to the City in times of water shortage (dry years and droughts). Through Louisville's ownership of

9 units of Windy Gap water supplies, the City is entitled to 2,700 AF in Chimney Hollow Reservoir and the guaranteed firm water yield is anticipated to average 600 AF per year. Windy Gap Firming water is reusable, however acquisition costs are substantially higher than C-BT units.

Louisville Water Facilities

Water operations at the City of Louisville involve the following components: raw water diversions and deliveries to storage facilities, distributions to the treatment plants, reuse from the wastewater treatment plant, and deliveries to the golf course and parks to the extent water is available. This section describes each phase of the operations system.

Ditches and Pipelines

Louisville has three main conveyance structures from which the City obtains its raw water supplies: Community Ditch, Louisville Pipeline, and the Southern Water Supply Project pipeline. An ancillary structure is the Louisville Lateral, the predecessor to the Louisville Pipeline.

Community Ditch



Community Ditch

The Community Ditch, the City's primary diversion structure on South Boulder Creek, is located near Eldorado Springs. The ditch diverts both storage (winter) and direct flow (summer) water rights and has a maximum capacity of approximately at 250 cubic feet per second (cfs). The Community Ditch can be used to divert the City's Marshall Lake share water (direct flow and storage), the City's SBCC share water, and the City's Other SBC water.

The Community Ditch is owned and operated by FRICO and Louisville is allowed to use the ditch pursuant to several FRICO/Louisville agreements, the latest signed in 1992. The City's diversions are coordinated on a daily basis with FRICO and water commissioner to divert the City's water entitlements.

Louisville Pipeline

The Louisville Pipeline also diverts from South Boulder Creek near Eldorado Springs and can deliver water to the SCWTP, Harper Reservoir, Louisville Reservoir, HBWTP, or Marshall Reservoir. It is owned solely by the City. The design capacity of the pipeline is 7.7 cfs, but recent diversions have been closer to 5.0 cfs. The Louisville Pipeline can be used to divert the City's Marshall Lake share water (direct flow and storage), the City's SBCC share water, and the City's Other SBC water.

Typically, the pipeline operates year round delivering direct flow water rights in the summer and Louisville Reservoir storage rights in the winter. Pursuant to the reservoir's storage decree, Louisville is allowed to store up to 210 AF annually during dry years winter periods. Most of Louisville's senior water rights are entitled to divert at the Louisville pipeline and/or the Community Ditch. Therefore, especially during drought periods, the pipeline offers the City a primary diversion point that increases yield to the city at a rate up to 10 AF per day.

Additionally, Louisville has an agreement with the Town of Eldorado Springs that allows the Town to use a small portion of the pipeline capacity for its water rights' operations. This agreement does not impair Louisville's ability to fully utilize the capacity of the pipeline, but it does provide Eldorado Springs the required infrastructure to operate its water system in compliance with its water court decree.

Louisville Pipeline Diversion Structure

SWSP Pipeline

The SWSP delivers C-BT/Windy Gap supplemental water directly to the SCWTP or to Louisville Reservoir. The pipeline's capacity is 4.2 cfs. In the summer months, the SWSP cannot fully meet the SCWTP demands, and therefore a combination of SWSP deliveries and diversions from the Louisville Pipeline, Harper Reservoir, or Marshall Lake releases are required.

Louisville Storage Facilities

The City has access to four reservoirs to store its raw water supplies: Marshall Lake, Harper Reservoir, Louisville Reservoir, and McKay Reservoir. Marshall Lake and McKay Reservoir are owned and operated by FRICO. Harper and Louisville Reservoirs are owned by the City. The following is a brief description of the operation for each storage facility and its role within the City-wide water storage system.

Marshall Lake



Marshall Lake

Marshall Lake is the primary storage facility for the City with a storage capacity of 9,655 AF; Louisville's pro-rata portion is approximately one-third of the total capacity. Use and operation of the reservoir is primarily shared between other FRICO shareholders (irrigation use) and the City (municipal use). In addition to Marshall Lake share water, the City can store Other SBC Water (Foreign Water) in the reservoir.

Louisville's use of Marshall Lake is subject to the terms of the 1992 FRICO/Louisville Agreement.

There are two basic operational scenarios related to City operations:

Scenario 1: Marshall Lake fills to full capacity in April-May

Scenario 2: Marshall Reservoir does not fill to capacity during the year

If the Marshall Lake fills to capacity, Other SBC Water/Foreign Water stored in the reservoir during the prior water year is booked over (a.k.a. spilled) to make storage space available for Marshall Lake share water. Once the irrigation releases from the reservoir begin, usually in late-July, storage space becomes available in Marshall Lake. At that time, Louisville is then entitled to store its Other SBC/Foreign Water supplies in the "excess" storage space created by these irrigation releases from FRICO storage.

In those years that the reservoir does not fill during the preceding winter storage season, Louisville's prior water year Other SBC/Foreign Water does not spill and the City is typically able to store this water year's Other SBC/Foreign Water in Marshall Lake's excess space beginning in April. Factors that determine whether Marshall Lake fills each year is a function of the previous year's carry-over in the reservoir, winter snowpack, and springtime runoff flows in South Boulder Creek. Releases from Marshall Lake supply the HBWTP; Marshall Reservoir can also deliver water to the SCWTP and the golf course, but only through the Louisville Lateral and Cherry Street Pipeline.

Harper Reservoir

Harper Reservoir is a secondary storage site for Louisville and has a capacity of approximately 750 AF. Harper Reservoir is supplied by the Louisville Pipeline or Louisville Lateral. Water delivered from Harper Reservoir can be stored in Louisville Reservoir or used directly at the SCWTP.



Harper Reservoir

Louisville Reservoir

Louisville Reservoir is operated as a “forebay” to the North Plant. Its purpose is to supply water directly to the SCWTP, which is located adjacent to the reservoir. The reservoir has a capacity of 210 AF and is rarely lowered below 190 AF. Water deliveries to the reservoir are made through the Louisville Lateral, the Louisville Pipeline, or the SWSP Pipeline.

McKay Reservoir

McKay Reservoir is located in the Big Dry Creek basin outside of the City’s water delivery system and, therefore, does not directly contribute to City’s raw water supply. Instead, McKay Reservoir can be used to fulfill certain legal requirements associated with the City’s Marshall Lake Division’s direct and storage rights. As a result, McKay Reservoir serves a solely administrative function for the City. However, recent court cases involving Marshall shares from the Big Dry Creek basin have required return flow obligations



McKay Reservoir

to be released to the Big Dry basin to maintain the historical flow patterns. City water stored in McKay Reservoir can potentially be released to fulfill these obligations. Further, it is anticipated that future Marshall Lake shares acquired by the City or any other municipality will have similar return flow obligations to Big Dry Creek. As a result, the future use of McKay Reservoir is expected to integrate more fully into the City-wide operations and have an increasing level of use to meet Louisville’s Big Dry Creek return flow obligations.

System Constraints

In Louisville’s collection and distribution system, not all available water supplies can be utilized at their maximum levels due to constraints involving pipeline capacity, storage capacity, timing of available

supplies, and timing of City's daily municipal demand. As a result, water supplies have historically been diverted at lower rates than the City's maximum legal entitlement because of these constraints.

Many of the constraints listed below occur in only extreme conditions: drought or high flows. However, many other constraints are chronic issues that occur irrelevant of the annual streamflow or supply source. While these constraints are limiting factors affecting the City's water supply system and subsequent delivery to the treatment plants or reservoirs, modifications to specific system operations can be made to address these constraints and minimize their effects.

Three issues are directly or indirectly related to the potential use of the Louisville pipeline: pipeline capacity, timely head gate operations, and a lack of available City storage during April 15 - July 15.

Constraint No. 1 – Louisville Pipeline

The Louisville pipeline has a design capacity of 7.7 cfs, when utilizing the booster pump station. Typically operations are in the range of 2.0 – 5.0 cfs to ensure pipe pressures do not stress the system. Throughout the study period, South Boulder Creek records indicate that streamflows in excess of the pipeline flow capacity were available at various times to divert at the pipeline. Consequently, the records consistently demonstrate that water which could have been diverted to the City's treatment plants and reservoirs, was instead bypassed at the intake on South Boulder Creek. For example, in 2014-2015, 82 AF of water was not diverted at the pipeline at times that demand and/or storage was available but pipeline capacity was limited.

Lack of timely head gate operations also limits the use of the pipeline. Daily water rights administration can dramatically change during the summer months due to rainstorms. Subsequent storm water runoff becomes available at the pipeline for short periods of time (1-3 days) as the storm surge moves downstream. However, time constraints related to shifting manpower duties, required travel distance to the pipeline headgate, and daily (even hourly) communication requirements between staff members cause much of this available storm water to bypass the pipeline intake before the adjustments can be completed. Historically, on average, 155-180 AF per year has not been diverted due to operational constraints. However, it is anticipated that recent (2016) repairs and projected improvements at the pipeline intake will address the majority of these operational issues.

Constraint No. 2 – System-Wide Storage Capacity

Storage space is a limiting constraint to optimize water yields from Louisville's water rights portfolio. At times during the study period, Louisville had more water yield than available space to store it. For example, on years that Marshall Lake fills to capacity (63% of the time), an average of 680 AF of foreign water stored in Marshall Lake the previous year by Louisville is "spilled" from the reservoir to make space for water diverted under FRICO's Marshall Lake Division storage rights. (This water is not physically spilled from the reservoir but rather "booked" from the Louisville account over to the FRICO account in Marshall Reservoir.) When Marshall Reservoir spills occur, up to approximately 67% of this water is lost from Louisville's system and cannot be recaptured by the City. The remaining 33% amount is redistributed to the City through its ownership of its Marshall Division shares.

Some water rights were not diverted during many years of the study period due to lack of existing daily demand levels and/or storage space. This was anticipated in Louisville's earlier Raw Water Management

Plans with the understanding that many of the rights would be primarily used for the following purposes:

- Drought protection, and thus not diverted during average years;
- Refill of the City's storage facilities following a drought;
- Meeting the City's future demands up to build-out levels.

Storage limitations also have a significant impact on South Boulder Creek diversions. At certain times during the year (April-July) in which Louisville is entitled to divert, the system-wide storage capacity often has no excess capacity to store potential diversions. As a result, the only option is to bypass the flow at the Community Ditch headgate and/or the Louisville Pipeline intake. On average, system-wide storage constraints decrease diversions at the pipeline by 300 AF per year.

Constraint No. 3 – SWSP Pipeline Capacity

C-BT water deliveries to the City from the SWSP are currently limited to a 4.2 cfs flow rate because of pipeline capacity limitations (Louisville has the ability to increase the pipeline capacity to 7.2 cfs, effectively improving the City's firm yield during droughts). While the 4.2 cfs flow rate is adequate for wintertime deliveries, the SCWTP summertime demands exceed this flow rate. Therefore, historically during the summer months, C-BT units have been considered supplemental supplies for use at the SCWTP. The reasons for this were two-fold: (1) South Boulder Creek supplies are less expensive to deliver to the treatment plants (gravity flow); and (2) flow restrictions associated with the SWSP. These restrictions preclude higher C-BT delivery rates during summer peak demands and prolonged drought periods, resulting in larger releases from Marshall, Harper, or Louisville Reservoir. These releases from the City's storage facilities may cause implementation of Louisville's Drought Plan, despite adequate stored C-BT's supplies within the NCWCD system.



Southern Water Supply Pipeline – Northern Water

Due to high operational costs (pumping costs and annual assessments) it is more economical for the City to use its C-BT annual allocations prior to any use of Windy Gap Firming diversions. Because the City has sufficient C-BT water supply in average runoff years, Windy Gap Firming water would be used during only drought periods. However, until the Windy Gap Firming Project is completed with east slope storage, the water supply is not considered a viable water supply source in dry year periods.

Additionally, the lack of capacity in the SWSP also limits the City's ability to deliver Windy Gap Firming water. Firm yield analysis results show that for Louisville to reach the maximum firm yield levels with its current water supplies, C-BT and Windy Gap Firming supplies need to be diverted simultaneously to the SCWTP.

Constraint No. 4 – Louisville Lateral

Use of the Louisville Lateral was limited during the study period due to conveyance and maintenance issues related to the structure. Only two short-term releases were made from Marshall Lake to the lateral in 2007 and 2008. Therefore, it's generally recognized that during the study period there was no demand for the lateral's use - given that the SCWTP demands were met through the Louisville Pipeline.

Expected future use of the Lateral is related to the SCWTP water deliveries at times when demands exceed the Louisville Pipeline capacity. At such times preserving C-BT water sources is possible and desirable, the lateral could be operated simultaneously with the pipeline to maximize South Boulder Creek water deliveries to: (1) Louisville Reservoir for later diversion into the SCWTP; or (2) Harper Reservoir for subsequent delivery to Louisville Reservoir.

Constraint No. 5 - South Boulder Creek's Instream Flow

The Colorado Water Conservation Board ("CWCB") filed an instream flow water right below the reach of South Boulder Creek from which Louisville diverts at the Community Ditch and the Louisville Pipeline. The purpose of the instream flow right is to protect the fishery and riparian habitat from low streamflow conditions. The filing was made in December, 1980 for 15 cfs minimum flow rate in the summer and 2 cfs in the winter. For a variety of legal reasons specific to in stream flow rights, the CWCB water right is administered as a "senior" right to approximately 82% of Louisville's South Boulder Creek water rights. Therefore, at times the instream flow water right is the calling right on South Boulder, Louisville must curtail a majority of its diversions.



South Boulder Creek - Howard Ditch Headgate

DATA COLLECTION AND HISTORICAL TRENDS

Previous water planning reports conducted for the City utilized sophisticated computer modeling techniques to assess current and future water operations. RBI used the results of these modeling efforts, extended the previous master plan database, and then combined them with the practical experience of operating Louisville's water rights system to provide: (1) a description of the ongoing

management practices; and (2) changes to the current system and evaluate future operation alternatives.

Period of Record

The study period for this report's database was 2004-2015. The database included available information related to the City's water demands and supplies during these specific years. Once developed, the 2004-2015 database was integrated with the 2003 Raw Water Master Plan's database to create a continuum of data through 2015. The City's "water supply" was calculated using the historical daily, monthly, and annual amounts of water diverted and stored. Conversely, treatment plant records, golf course irrigation use, and other reuse needs comprised the City's overall "water demand" amounts.

The period of record also reflects conservation measures implemented by the City, recent system-wide improvements, and all additional water right acquisitions since 2003.

Diversion Records

Diversion records were obtained from the City's historical monthly and annual accounting reports submitted during the study periods to the following agencies: (1) the State Engineer's office; (2) FRICO; and 3) South Boulder – Coal Creek Ditch Company. Data for years 2000-2003 were derived from the Louisville's 2003 Raw Water Master Plan. Additionally, the City's internal accounting software records were used to supplement missing data. If there was discrepancy between the various databases, the lowest and most conservative recorded values were used in the analysis. Total diversions from the City's various water supply sources are listed in the table below for each month of the study period.

Table 2
City Louisville Historical Water Diversions
(acre-feet)

| Water Year | Marshall Storage | Marshall Directs | Other SBC Water | C-BT | Windy Gap | Total |
|------------|------------------|------------------|-----------------|------|-----------|-------|
| 2000 | 1746 | 1022 | 2973 | --- | 0 | 5741 |
| 2001 | 1940 | 6938 | 4514 | 521 | 0 | 13913 |
| 2002 | 645 | 0 | 2222 | 722 | 0 | 3589 |
| 2003 | 1179 | 1309 | 1422 | 256 | 0 | 4166 |
| 2004 | 1129 | 1660 | 1790 | 0 | 0 | 4579 |
| 2005 | 1613 | 1205 | 1998 | 30 | 0 | 4846 |
| 2006 | 968 | 2106 | 2008 | 66 | 0 | 5148 |
| 2007 | 1613 | 1317 | 1640 | 21 | 0 | 4591 |
| 2008 | 968 | 2190 | 2153 | 0 | 0 | 5311 |
| 2009 | 1779 | 280 | 1725 | 28 | 0 | 3812 |
| 2010 | 1779 | 1379 | 1050 | 80 | 0 | 4288 |
| 2011 | 1456 | 1658 | 1289 | 160 | 0 | 4563 |
| 2012 | 1203 | 0 | 2229 | 991 | 0 | 4423 |
| 2013 | 1492 | 742 | 1778 | 967 | 0 | 4979 |
| 2014 | 1497 | 1809 | 3880 | 637 | 0 | 7823 |
| 2015 | 1520 | 3501 | 1858 | 1031 | 0 | 7910 |
| Ave | 1408 | 1695 | 2158 | 367 | 0 | 5605 |

Note: Other SBC Water is referred to as Foreign Water when diverted in FRICO's facilities

The results indicate that diversions during the 2000-2015 study period are consistent with the trends reported in the earlier master plan reports (1992, 1998, and 2003), including the typical annual variations reflected in South Boulder Creek diversions and C-BT allocations. No significant changes from previous reports (and study periods) were identified during this study period.

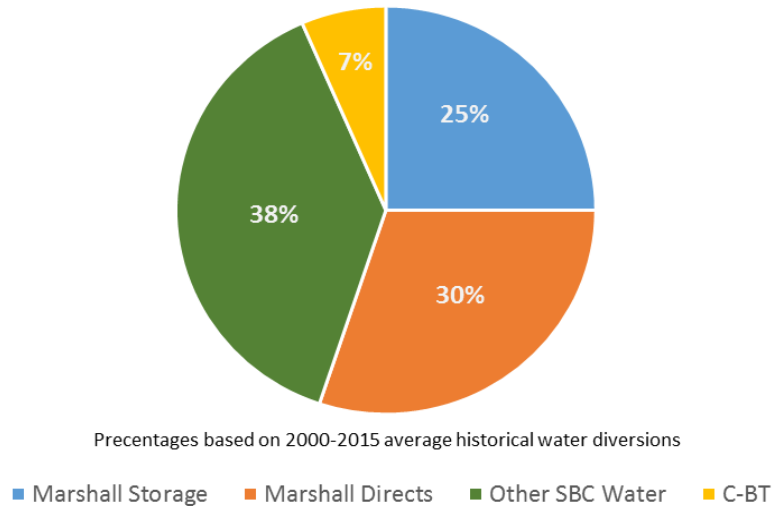
For future consideration, it is not anticipated that hydrological conditions will change significantly in the short term, but long term, climate change impacts may alter historical flow conditions – most notably in the timing of the runoff season.

Nevertheless, this historical trend analysis provided the baseline data to investigate the City's current water supplies (yields) and the foundation to assess existing and future city-wide operations.

Average Distribution of Supplies

The average annual allocation of supplies from each of the City's water sources during the 2000-2014 study period is illustrated in Figure 2.

Figure 2
Allocation of Raw Water Supplies



Historical Demands

Total treatment plant production at the HBWTP and SCWTP was summarized to develop a baseline monthly and annual demand for raw water during the study period. Production numbers varied widely and the historical data reflected conservation measures implemented by the City in times of supply shortages. Annual demands are shown in Table 2.

Table 3
City of Louisville Raw Water Demands
(acre-feet)

| Month | Nov | Dec | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Total |
|-------|-----|-----|-----|-----|-----|-------|-----|------|------|-----|------|-----|-------|
| 2000 | 247 | 205 | 197 | 188 | 220 | 326 | 602 | 749 | 792 | 738 | 554 | 308 | 5126 |
| 2001 | 192 | 202 | 210 | 178 | 206 | 247 | 443 | 716 | 776 | 721 | 575 | 354 | 4820 |
| 2002 | 215 | 197 | 196 | 187 | 213 | 369 | 453 | 387 | 448 | 393 | 318 | 225 | 3601 |
| 2003 | 153 | 169 | 172 | 154 | 153 | 168 | 347 | 478 | 701 | 627 | 408 | 345 | 3875 |
| 2004 | 162 | 163 | 175 | 163 | 188 | 186 | 390 | 446 | 479 | 457 | 412 | 220 | 3441 |
| 2005 | 163 | 170 | 175 | 149 | 171 | 195 | 353 | 496 | 731 | 582 | 522 | 241 | 3948 |
| 2006 | 191 | 174 | 174 | 166 | 175 | 303 | 574 | 702 | 643 | 618 | 442 | 257 | 4419 |
| 2007 | 157 | 174 | 176 | 157 | 182 | 200 | 376 | 623 | 743 | 632 | 509 | 296 | 4225 |
| 2008 | 173 | 166 | 170 | 164 | 174 | 210 | 410 | 591 | 797 | 665 | 443 | 252 | 4215 |
| 2009 | 179 | 175 | 179 | 161 | 193 | 192 | 383 | 388 | 550 | 585 | 512 | 216 | 3713 |
| 2010 | 167 | 175 | 170 | 170 | 158 | 185 | 301 | 497 | 577 | 591 | 535 | 308 | 3834 |
| 2011 | 171 | 184 | 180 | 164 | 179 | 226 | 345 | 546 | 550 | 655 | 493 | 304 | 3997 |
| 2012 | 158 | 173 | 169 | 155 | 196 | 309 | 493 | 672 | 649 | 672 | 491 | 233 | 4370 |
| 2013 | 177 | 181 | 181 | 151 | 162 | 158 | 311 | 590 | 649 | 592 | 344 | 189 | 3685 |
| 2014 | 159 | 163 | 168 | 150 | 171 | 203 | 353 | 544 | 617 | 530 | 377 | 234 | 3669 |
| 2015 | 155 | 169 | 166 | 143 | 163 | 207 | 234 | 375 | 481 | 606 | 563 | 409 | 3671 |
| Ave | 176 | 177 | 179 | 163 | 181 | 230 | 398 | 550 | 636 | 604 | 469 | 274 | 4038 |

Note: The Coal Creek Golf Course average annual total demand is an additional 210 AF.

DROUGHT MANAGEMENT PLANNING

Design Drought Determination

Previous raw water master plans included an analysis of historical flow records on South Boulder Creek to identify past droughts with respect to duration, severity, and frequency of re-occurrence. The purpose of the analysis was to determine the type of drought (“design drought”) for which Louisville should use for planning and management strategies. From the design-drought analysis, the City’s water supplies and demands are compared to identify any water shortages. The amount of Louisville’s water supply during all years including a drought is commonly referred to as “firm yield” which is generally derived from the City’s more senior water rights. In previous water planning reports, the 24-month period from March-1963 to February-1965 was selected as the “design-drought” for the City’s future water supply planning.

These previous design drought analyses were reexamined for accuracy and to assess the feasibility of replacing the previous 1963-1965 design-drought with a more predictive period. The 2003 Raw Water Master Plan’s hydrological records were updated through 2015 and then used to determine the need for a new design-drought. The result of this re-examination was that the criteria for using the 1963-1965 drought period continues to be applicable and provide the most representative design period for City-wide drought planning.

To project drought impacts to the City, the 1960’s drought represents the unique set of circumstances and factors that most significantly affect the City’s raw water supply. The 2002 drought is the most significant drought year during the study period, but the one year duration allowed City-wide storage to substantially refill in 2003. Further, while the drought of 1952-1957 was more severe in terms of low streamflow records on South Boulder Creek, using the 1960’s drought-design period produces more significant drawdown in storage, and consequently, has a higher level of impact on developing and implementing drought management actions.

Therefore, in the case of Louisville, categorizing drought events only by its associated reoccurrence level (example: 1-in-50 years) has been determined to be inappropriate. A more important parameter with selection the proper design drought is the duration of the drought and its impacts on storage levels. The duration is an important because: (1) extended droughts generally do not occur frequently enough to justify the expense to protect against them in the future; (2) extended droughts are generally less severe in any given year but occur for longer periods, and (3) short-term (18 months or less) droughts do not fully impact City-wide storage for long periods and therefore have much less significant impacts on water operations. For Louisville, the 2-year duration of the 1960’s design-drought was selected because of its critical impacts on City storage levels.

The key factor in assessing drought actions for Louisville is associated with the drawdown of City-wide storage levels during the first two years of the drought. The City currently has a two-year storage buffer available for the design-drought periods. During the first year of the design drought, water storage levels are drawn below average end-of-water year (November 15th) recorded levels. During the second year, the City is reliant on its carry-over from the previous year and the firm yield amount of water supplied in the second year. If the storage drawdown rate is significantly higher than previous (typical) years during the first year of the drought, then the City must rely on its firm yield water supplies and,

simultaneously, implement management strategies to address drought conditions and reduce City-wide water demands throughout the second year.

For these reasons, the design drought for this analysis was selected as the 2-year, 1963-1965 hydrological period on South Boulder Creek. The results from this analysis indicate that the City has a firm yield approximately 6,500 AF annually. Firm yield sources include senior South Boulder Creek water rights, City-wide winter storage, Colorado-Big Thompson and Windy Gap Firming water supplies.

Implementing Drought Management Restrictions

A critical component to properly manage the City's water resources during drought periods is to identify the appropriate time to implement the Drought Plan. Implementing the drought plan too early results in supplies exceeding demands, negating the need for outdoor water restrictions. Contrarily, implementing restrictions too slowly results in drawing City-wide storage levels significantly below average, causing the City to reduce its carry-over supplies for subsequent use if drought conditions continue.

Drought management restrictions not only lower total City-wide water demands, they also lower the amount of revenue the City's water billing will generate during the period in which the restrictions are enforced. Therefore, imposing outdoor water restrictions too early in the spring has the potential to lower the City's annual water revenue. In contrast, imposing water restrictions too late in the spring may cause the City to have to purchase or lease water at an inflated cost to supplement supplies during droughts.



Sprinkler

The time of year in which drought management restriction are determined will depend on a variety of hydrological factors: winter snowpack within the South Boulder Creek, projected C-BT's west slope deliveries, Marshall Lake carry-over storage supplies, and the City's March-April water usage. At times snowpack levels are significantly below-average within the South Boulder Creek drainage (e.g. 2002), it is reasonable to anticipate water restrictions during April-October. However, at times when snowpack levels are only marginally below average, timing the drought management actions becomes more difficult. Historically, during times of low spring snowpack within the basin, the City relied more heavily and earlier on C-BT supplies prior to implementing outdoor watering restrictions. By doing so, the City prevented the need to impose drought restrictions too early in the summer irrigation season, but risked the need to implement the same restrictions later in the summer (July-August) or the following spring.

Outdoor watering restrictions need to be consistently implemented only at times they are determined to be season-long actions (as a minimum). Public perception is important to obtain compliance with watering restrictions, and inconsistency and/or "false alarms" associated with the timing of watering restrictions erodes public confidence and compliance with the City's drought rules and management. Generally, a high level of consistency can be achieved by assessing the City's water supplies by May 1 (or earlier) of each year. For example, during the first year of the design-drought period used in this study, watering restrictions would be unlikely. However, by May 1 of the second drought year, indicators

(snowpack/runoff predictions, Marshall Lake carry-over storage, recorded City demands, and projected C-BT deliveries) are anticipated to indicate the need and level of watering restrictions to match estimated water supplies.

CLIMATE CHANGE

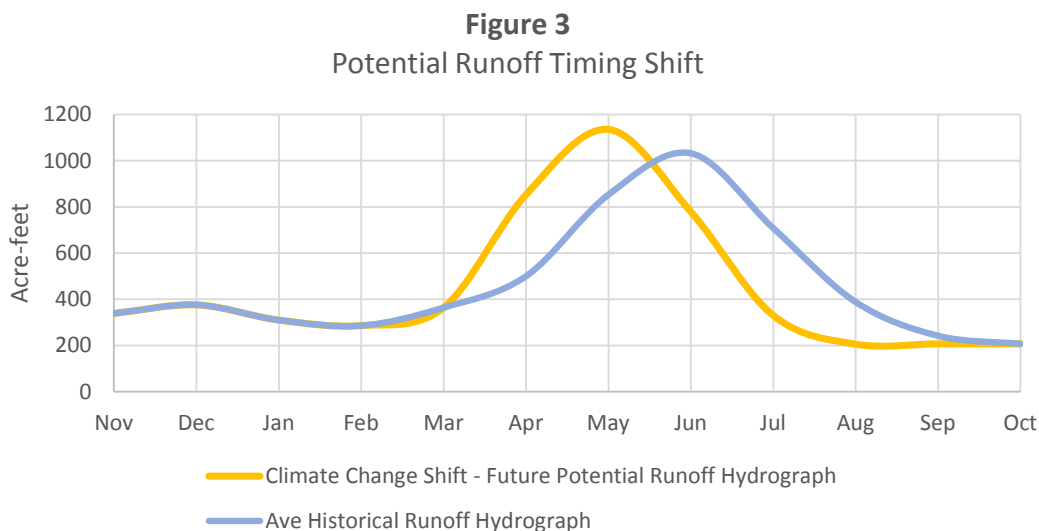
Climate Change Modeling Review

RBI has reviewed climate change modeling results that apply to the South Boulder Creek, Boulder Creek, and the South Platte River to assess potential long term impacts on the regional hydrology, water rights administration, and city water operations. Because of the wide variations and uncertainty in the modeling results, only general conclusions are offered below. As Louisville proceeds with future water resource management planning and as additional modeling results become refined, it is recommended that the City review these findings and make appropriated modifications as necessary.

Predicted Result – No. 1: Hydrology

The consensus of the models reviewed (Colorado Water Conservation Board, Boulder Climate Change Study (2009)), Joint Front Range Climate Change Vulnerability Study (2012), Colorado State University Technical Report 12-203(a) indicates the following:

- The runoff period on South Boulder Creek will gradually shift 20-45 days earlier from May 20 – June 22 to April 20 – May 22

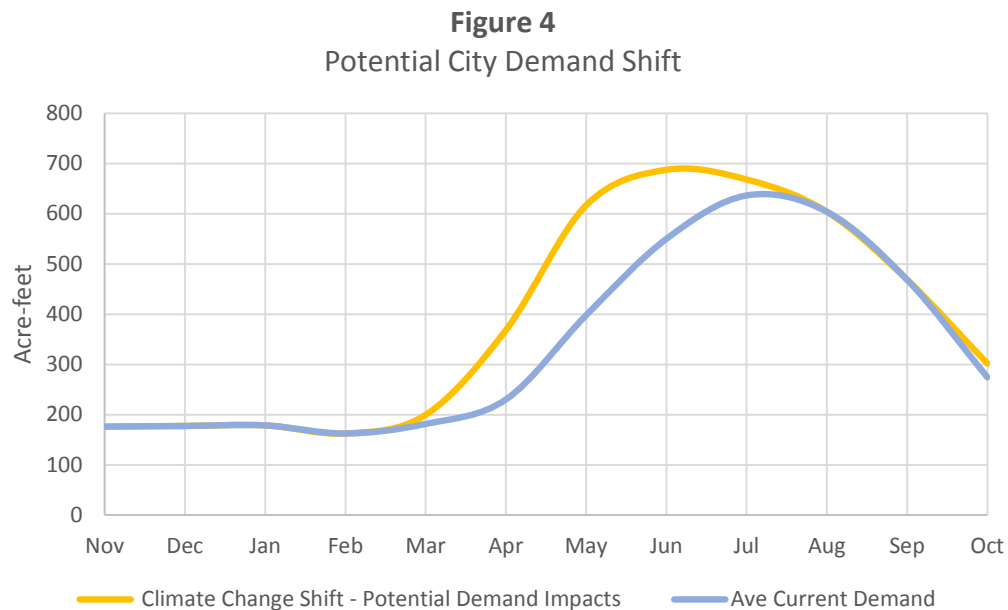


Other climate change assumptions also to be considered with runoff shift effects:

- Winter precipitation will increase 10-20%; summer precipitation will decrease 5-15%
- Annual runoff and stream flow volumes will be increased up to 10%
- Late summer stream flows will decrease 8-10 %
- Extreme climate conditions (droughts and floods) will increase in frequency and duration.

Predicted Result – No. 2: Water Demands

- City demands will shift from April – September to March – October



Other climate change assumptions also to be considered with potential City demand shift effects:

- Annual irrigation demand volumes are projected to increase 5-15% without City imposed limitations
- Daily temperature increases will also increase daily evaporative reservoir losses at Marshall, Harper, McKay and Louisville Reservoirs, decreasing the potential annual yield released from each.

Predicted Result – No. 3: Operational Changes

- Marshall Reservoir will fill to capacity less frequently
- Junior water rights (foreign water) will be diverted more frequently in March and April
- Total peak runoff diversions will decrease
- Post-peak junior diversions will increase
- Senior rights will be used in June-October period rather than July- September
- Decreed monthly and annual volumetric limits will be reached more frequently for all of Louisville water rights, but most notably for the City's senior water rights
- Higher evaporative losses from the City's reservoirs.

Predicted Result - No. 4: Colorado River Compact

- More frequent and longer droughts are anticipated to reduce flows within the Colorado River basin

- River flows are reduced over time, and the associated storage levels within the basin are reduced in prolonged drought
- The likelihood of a Colorado River Compact call being placed on the Colorado River increases from “unlikely” to “possible” and some models show “probable”.
- A compact call will reduce or eliminate deliveries from C-BT and Windy Gap water supplies
- Specific impacts to the Louisville’s water supplies based on a Colorado River call would require specific system wide modeling for the City’s delivery system.

Watershed Protection

- Increased wildfire danger - increase frequency and duration
- Increased runoff due to extreme thunderstorm events
- Increased flash-flooding - local tributary capacities exceeded (Dowdy Hollow).

ALTERNATIVES

The City has adopted many of the recommendations provided in the 2003 Raw Water Management Plan. Consequently, an updated evaluation of the raw water supply system now includes these previous recommendations, and as result, the current baseline has been established against which to compare other future alternatives.

Current Water Supply and Demand

Louisville’s average annual demand currently is 4,250 af/year. The City’s firm yield is also currently estimated at 5,000 af/year. This is based on data for water treatment plant deliveries (demand) and the historical South Boulder Creek diversions and SWSP deliveries to SCWTP (supply). Therefore, based on the current level of demand, the City has sufficient supplies to meet average demands without imposing watering restrictions.

However, it is anticipated that future demands will increase; at time of this report the City’s build-out demand is somewhat uncertain. RBI was provided three likely demand levels at the time the City’s build-out occurs:

- 6,100 AF per year – (estimate provided by Louisville’s Water Efficiency Plan)
- 6,500 AF per year – (estimate provided by the draft Drought Management Plan)
- 7,120 AF per year – (previous Water Master Plan estimated build-out demand from 2003).

For each of these build-out demand levels, the difference between build-out demand and current water supply systems was analyzed to determine:

- The amount of water supply shortfall based on the future firm yield estimates
- The adequacy of current drought management practices to address these shortfalls
- List alternative actions the City may consider reducing overall City demand during drought periods

- List alternative actions the City may consider increasing its water rights portfolio and drought water supplies.

The results of this particular analysis are provided below. Costs for the alternatives are estimated, although the water markets' volatility in northern Colorado is a consideration for any future water acquisition.

No Additional Action

Most City-wide planning documents include a "No Action" alternative addressing the current situation and impacts in the future. For this report, the recommendations listed in the 2003 Raw Water Management Report adopted or to be adopted by the City are included in the No Additional Action alternative (e.g. load shifting, obtain Windy Gap Firming supplies, and increase in SWSP capacity).

The No Additional Action alternative is used to quantify the impact of using only the current City's supply system to meet future projected demands. No Additional Action, however, does not imply that the City will not decide to improve/repair/construct its water supply infrastructure, discontinue its water leasing to other local users, or make other management decisions that will improve the efficiency of the raw water supply system.

The No Additional Action does accurately reflect Louisville's current water and storage supplies and the City's sole reliance on the existing firm yield water supply during future droughts. Consequently, as build-out demands approach and potential shortfalls occur, City management may need to invoke drought management strategies earlier and more frequently if not combined with other alternatives.

The components of the No Additional Action alternative are listed below:

| <u>Firm Yield</u> | <u>(AF/yr)</u> |
|---|----------------|
| Current: | 5,000 |
| Current with No Additional Action Alternative | 6,500 |
| <u>Demand</u> | |
| Current (average) | 4,250 |
| Build-out Scenario No. 1 | 6,100 |
| Build-out Scenario No. 2 | 6,500 |
| Build-out Scenario No. 3 | 7,120 |

The analysis shows that the City has sufficient water supplies to meet its near-term demands. To meet demands at the three build-out levels, the City must implement load-shifting from the HBWTP to SCWTP, enlarge the SWSP pipeline to SCWTP (to 7.2 cfs), and utilize water conservation measures to ensure that demands do not exceed firm yield supplies. These measures increase the yield to 6,500 AF per year, which meets the two lesser demand scenarios. Build-out #2 scenario was selected as the "Baseline Demand" to assess the City's need to acquire additional water supplies and/or storage. If future build-out demands are less than the "Baseline Demand", the City may avoid engaging in future water and/or storage acquisitions. Conversely, to meet the build-out #3 (7,120 AF) scenario, a water acquisition plan becomes necessary. Additionally, in the build-out #3 scenario, load-shifting, water conservation, and watering restrictions (10-15% reduction) may be implemented to lower City-wide

demands to firm yield water supply levels. Below is a summary of potential alternative projects that could be utilized to improve the City's water resources.

Additional Storage

The acquisition of additional storage can be achieved two ways: (1) Marshall Lake Division shares; and 2) build or acquire additional storage space. Marshall Lake Division water includes direct and storage water rights based on the City's pro rata ownership in the division. Therefore, storage in Marshall Lake is included with every purchased share. In past City water reports, acquired or constructed storage space was considered prohibitively expensive. However, while costs remain relatively expensive, alternatives exist that warrant further consideration:

Enlargement of Gross Reservoir: Add one-foot of elevation to the dam height and create an 800-1,000 AF "excess" pool. The estimated cost is \$4-8 million. Cooperation with Denver Water, City of Boulder, and City of Lafayette would be an integral part of obtaining approval for such additional storage space in Gross Reservoir. Modifications to the reservoir inlet are also anticipated. Given the current status of Denver Water's project to enlarge Gross Reservoir, this option has a low feasibility valuation.

Enlargement of Marshall Lake: Previous reviews conducted by the City indicated that increasing Marshall Lake may be problematic because of the resulting increased footprint of the reservoir area. Increasing the dam height may cause alluvial groundwater to build-up behind the dam to levels that would have detrimental effects to the adjacent landowners (landfill) and Highway 93. While further investigation is needed, these preliminary findings reduce the viability of this storage alternative.

Marshall Lake Forebay: Construct a 600 - 1,000 AF forebay storage facility adjacent to Marshall Lake for the purpose of diverting "spill water" and in-priority junior water rights from Marshall Lake to the forebay. The initial proposed site is south of the HBWTP, property presently owned by Boulder Open Space. The estimated cost is \$12-\$15 million.

Storage Partnerships with Surrounding Communities: Collaboratively investigate storage opportunities with entities such as District 6 water users and the Cities of Lafayette, Superior, Firestone and Erie. Periodic meetings with participants from each entity would be conducted to identify water needs (volumes, amounts, timing) and build the framework for a storage project within the South Boulder Creek/Boulder Creek/South Platte River drainages.

Dredge Marshall Lake: RBI is not aware of any updated storage-capacity curves for Marshall Lake. Without an updated curves, water elevation levels may no longer accurately represent storage volumes in the reservoir. Therefore, preferably in collaboration with FRICO, updated Marshall Lake storage capacity curves need to be developed to assess the current storage volume. Once the curves are developed, the City and FRICO can assess the amount of dredging that is needed to maximize the benefits versus the costs. It is anticipated that only a small portion of the overall storage is affected and this recovery would need to be combined with other options. A planning level cost for dredging is estimated at \$2 million.

Excess credit leasing/trade: Develop a leasing program or partnership program (water trade) to utilize excess reuse credits in non-drought years. The available reuse water would be used at times the City's water excess credit supplies exceeds its demands. The excess water could be leased to generate revenue or traded with other entities for use of CB-T units, additional South Boulder Creek water rights,

or additional Marshall Lake shares. Terms and conditions of future leases will be contingent upon future water market demands.

C-BT/Windy Gap Conveyance to HBWTP

Load-shifting has proven to be a valuable management tool to maximize Louisville's water supplies, most notably C-BT and Windy Gap sources. However, load-shifting is only from the HBWTP to SCWTP to fully utilize C-BT and Windy Gap supplies especially during winter operations. Under the current water delivery system, no C-BT/Windy Firming Gap water can be diverted to the HBWTP.

Historically, Marshall Lake has been the primary source of water for the HBWTP. Using storage at Marshall Lake to meet the plant's demands rather than C-BT/Windy Gap Firming supplies has proven a cost-effective strategy (no pumping costs) and reserves C-BT/Windy Gap Firming water for later use at the SCWTP to carry the City through the design-drought.

However, recent events have illustrated the potential need for a C-BT/Windy Gap Firming conveyance to the HBWTP. Events such as the 2013 flood effectively eliminated the use of Marshall Lake due to high turbidity levels. Additionally, in 2015, repairs to the Community Ditch required closing the head gate during the middle of the summer, thereby eliminating any additional diversions into Marshall Lake. Further, diversion from the Louisville Pipeline to the HBWTP were curtailed by repairs in 2015, again impacting water yields at Marshall Lake. Also, ongoing water quality issues have hindered the use of Louisville Reservoir in late summer, thereby increasing the treatment demands at the HBWTP. Under all of these conditions, preserving Marshall Lake water shifted to a higher priority as a result of limited storage supplies.

As a result of these events, a potential option has developed for a conveyance facility to deliver water from SWSP to the HBWTP to address times when storage becomes limiting in Marshall Reservoir. A full feasibility analysis is required to assess the design and cost of the pipeline, but estimates range from \$8-20 million.

Enlargement of Louisville Pipeline

The upper operation range of the pipeline is between 5.0 and 5.5 cfs. Expanding the capacity of the line to 10 cfs increases the average South Boulder Creek yield by 400 AF; during drought years, firm yield would increase approximately 200 AF.

This updated analysis confirms the results of the 2003 Raw Water Master Plan. Given the cost of C-BT units and the uncertainty of water right transfers, optimizing infrastructure to increase water yield is an economically viable alternative. The enlarged pipeline would be designed to divert water that currently bypasses the headgate. If additional capacity existed, higher flow rates could be diverted in accordance to the City's water right entitlements.

However, the marginal benefits associated with enlarging the Louisville Pipeline are lessened by the lack of storage and seasonal demand in average years. While higher rates of diversion are possible with an enlarged pipeline capacity, storage of such water occurs only if space is available in Marshall Lake or Harper Lake. If these two reservoirs are at full capacity, maximum pipeline diversions would be limited

(equal) to daily treatment plant demands. However, it is anticipated that City future demands will increase resulting in higher diversion occurring at the pipeline.

Nevertheless, additional pipeline capacity would allow the City to reserve its Marshall Lake and C-BT allocations, thereby increasing Louisville's average and the firm yield water supplies. Further, no water court action to enlarge the pipeline is required if the location of the head gate on South Boulder Creek does not substantially change (which is not anticipated). The estimated cost is \$10-15 million, which converts to \$25,000 - \$37,500 per AF of increased yield.

Another advantage of enlarging the pipeline involves operational maintenance issues. The pipeline was constructed in the 1950's making it part of the City's aging infrastructure that will see an increase in repairs and maintenance. Rather than replace and repair the existing pipeline - with no increased capacity benefits - the City could adopt a replacement program that enlarges the pipeline to allow for future increased flows. This option gives the City the ability to maintain and repair the pipeline and simultaneously gradually increase its capacity. It is expected that if no replacement of the pipeline is undertaken by the City, the Louisville Pipeline will incur significant expenses for extensive repairs and unplanned water supply interruptions. A condition assessment of the pipeline is planned for 2017 whereby an estimated life expectancy and will be used to develop a long range maintenance plan.

Water Acquisition

The planning criteria for future water acquisitions is four-fold: (1) identify the City's projected water demands; (2) identify the City's firm yield supply amount; (3) identify shortfalls between current supplies and future demands; and (4) purchase the "type" of water that best serves the long term interest of the City.

Water Rights Considered for Purchase

Colorado's water markets have various types of rights available for purchase, including agricultural ditch rights, C-BT units, and Marshall Division shares. (Groundwater, based on earlier studies, is not considered a viable alternative water source for Louisville. Deep groundwater supplies are limited and considered not sustainable based on current ground water supply and pumping costs). Selecting the "best-fit" for Louisville requires an analysis that determines which of these purchase options meets the City's long term needs at the most cost effective manner. This section describes three alternatives.

Agricultural Ditch Rights

Louisville currently has 31 agricultural ditch water rights involving 14 irrigation ditches that have been transferred through water court for use within the City's municipal system. These water rights consist of a combination of senior and junior water rights, with 80% of the City's water diverted during the months of May - July. Former agricultural rights comprise the "foreign" water classification and can be legally stored in City reservoirs or directly diverted to the treatment plants. Each of these water rights has specific terms and conditions that define the timing and amount of water the City is entitled.



Ditch Flume

Agricultural irrigation rights within the South Boulder Creek basin generally do not have associated storage rights, but rather are solely direct flow rights that can be diverted only during the summer's irrigation season. Therefore, the value of these rights is limited at times the City's current storage facilities reach full capacity. Under these circumstances, direct flow agricultural rights can only be diverted to the treatment plants, with flow rates limited by daily city demands rather than the larger legal entitlement. As a result, foreign water is less valuable to the City when compared with the other sources.

Current purchase costs for agricultural water rights within the South Boulder Creek basin average \$25,000 - 30,000/AF. However, transactions costs (engineering and legal) to transfer these rights from agricultural to municipal use in Colorado's water court averages \$150,000 (2016). Comparable costs vary

depending on the amount of water transferred in each water court application. Therefore, the economies of scale for the purchase and transaction of these rights would indicate that it would be beneficial to acquire a large amount of water prior to undertaking any water court action by the City.

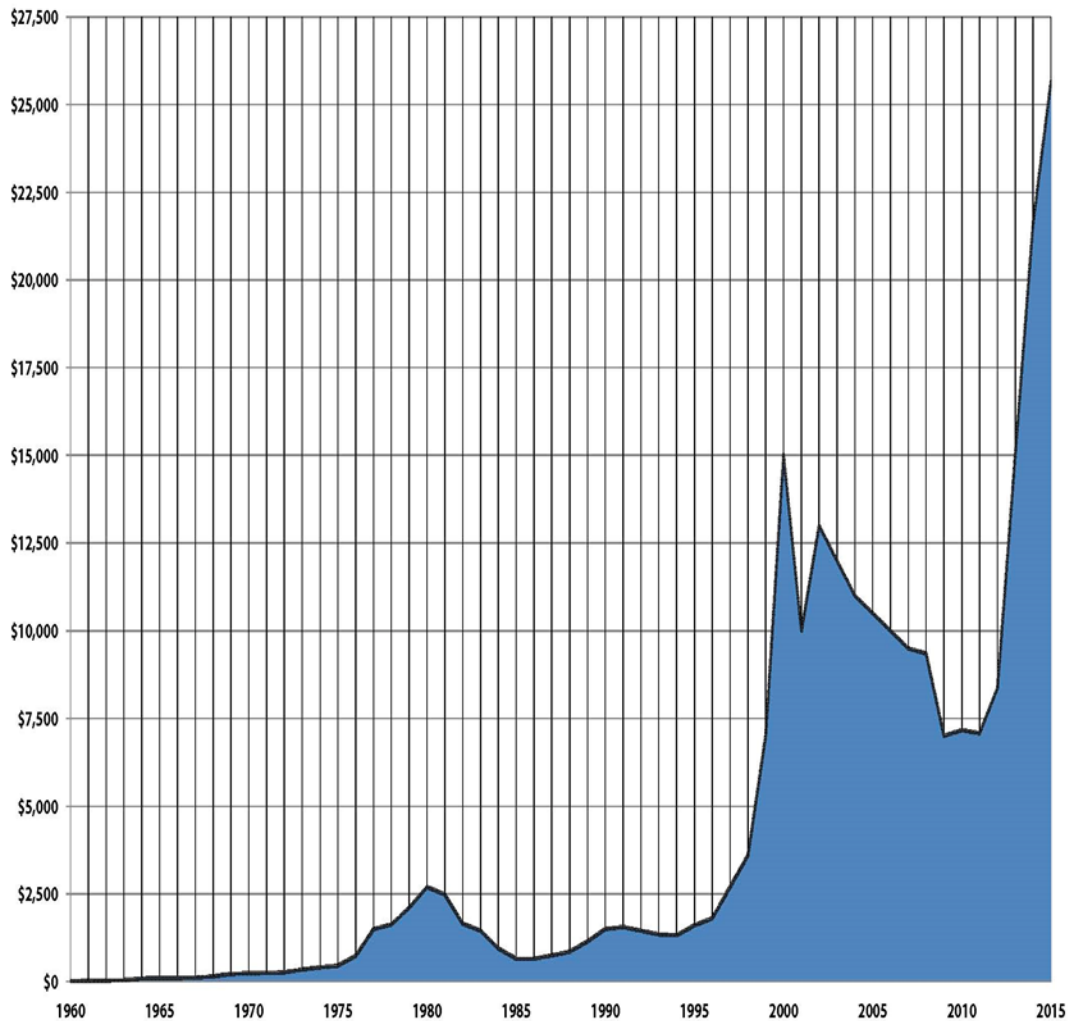
C-BT Units

The Colorado-Big Thompson Project diverts water from the headwaters of the Colorado River and delivers this water to various east slope reservoirs. Units of C-BT water can be bought and sold on the open market. Built originally during the 1930's to serve northern Colorado agricultural communities, C-BT units have been gradually acquired by municipal and energy interests and now make up the majority of usage.

Once collected on the west slope and diverted to NCWCD's east slope storage sites, C-BT units are not subject to Colorado's legal water allocation system and therefore offer more flexibility related a unit's time of use. However, C-BT units are subject to a Colorado River Compact river call, if one was to occur in the future. On average, a single C-BT unit equals 0.7 AF of water which was used in assessing future C-BT amounts and needs. C-BT units can be used year-round because of the storage component associated with each unit. As a result, the demand for C-BT water has been increasing over the last ten years, especially due to the recent increased demand from municipal interests.

The price of C-BT water has increased dramatically since 2010. Currently, the price of C-BT water is at record levels (\$23,000-\$27,000 per unit). Delivery costs to the City are currently \$35/unit, not including the \$17/AF pumping costs. Slowing energy development may lower prices in the near-term, but municipal demand has remained constant. Historical transactions indicate that C-BT costs do not fluctuate during drought and flood periods. However, historical economic variations in housing development in northern Colorado have proven to significantly impact the C-BT market.

Figure 5
Historical Representative Market Prices Per C-BT Acre-Foot Unit ⁽¹⁾



⁽¹⁾ District allottees of C-BT Project water may transfer and sell their respective acre-foot units to other parties within Northern Water boundaries. These transactions are subject to rules and regulations of the Board. The above table represents data gathered by voluntary action and serves as an indicator of how the price of C-BT Project water has fluctuated on the open market through the years. Actual transaction prices may vary.

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Northern Water

Windy Gap Units

Louisville owns 9 units of the Windy Gap Firming Project. Future shares of Windy Gap Firming will be associated with any acquisition of C-BT units. However, Windy Gap units may be purchased without associated C-BT units. Because of the project's junior water rights, Windy Gap Firming water cannot be diverted during low runoff years. Conversely, during wet periods, storage space in the project's west slope reservoir, Granby Lake, is not available for Windy Gap water because it has a lower "storage priority" (as determined by NCWCD) than C-BT Project water.

Chimney Hollow Reservoir will increase the Windy Gap Firming project's annual firm yield to approximately 30,000 AF. This equates to approximately 600 AF entitled to Louisville Windy Gap water, with storage, would be considered drought protection for the City. It is also the most expensive water acquisition alternative at \$1.4 million per unit and an annual debt service charge of approximately \$25,000/year. Delivery charges for Windy Gap Firming water to the City is currently \$130/AF, plus pumping costs (\$17/AF).

The expected commencement date of the Windy Gap Firming Project - and the construction of Chimney Hollow Reservoir - is anticipated to be mid-2018.

At the time of this report, there is potential to acquire additional Windy Gap units as several project participants have reassessed their respective positions and looking to reduce their unit total.

Marshall Division Shares

Louisville owns 381.64 shares in FRICO's Marshall Lake Division; the total number of Marshall Division shares is 1,278,979 shares. The Marshall Division water rights consist of the Marshall Lake Division direct flow priorities and the Marshall Lake and McKay Reservoir storage rights.

The storage capability in Marshall Lake differentiates Marshall Lake Division rights from other agricultural water rights within the South Boulder Creek drainage basin. As a result, the Marshall Division shares provide a higher value to the City because of the Marshall Division right's storage component. Recent sales of Marshall Division shares have averaged \$23,000 - \$30,000 per share, with each share averaging 4 AF/year.

South Boulder and Coal Creek Ditch Shares

Louisville owns shares of South Boulder and Coal Creek shares. Similar to Marshall Division shares, these shares also consist of a storage and direct flow water rights. No recent sales of South Boulder and Coal Creek Ditch shares have occurred. However, it is anticipated that such rights have a value comparable (if not slightly cheaper) than Marshall Division shares. Only about 12% of the company's shares are still untransferred. Prior City engineering reports indicated that Louisville's ownership in the remaining shares could assist in protecting the City's current interest in the ditch company in addition to providing additional water supply to the City.

Gross Reservoir

During the past few years, Louisville has participated in negotiations with Denver Water (owner of Gross Reservoir) and the cities of Boulder and Lafayette to assess the feasibility of acquiring storage in Gross Reservoir. Denver Water is undergoing a re-permitting process for the reservoir and has identified 5,000 AF of additional storage space ("Environmental Pool") in Gross Reservoir. The purpose of Environmental Pool is to store water for later release to benefit the riparian habitat along South Boulder Creek and supplement streamflows when the Colorado Water Conservation Board's instream flow is the calling right on the creek (late summer). An early version of the proposal from the participants included storing Boulder, Lafayette's and Louisville's water in the newly available storage space each given a specific amount of storage space based on each city's ability to use its own water rights for environmental purposes.

The other parties have decreed water rights for storage in Gross Reservoir; Louisville has no such right. This lack of decreed storage space in Gross Reservoir has severely limited Louisville's participation. Without a water source to store in the reservoir, Louisville does not have the ability to meet the Environmental Pool requirements. Further, Boulder and Lafayette have the ability to release water from Gross Reservoir, shepherd the water through the instream flow reach of South Boulder Creek, and recapture the water for use in the municipal system. Louisville, however, has no ability to recapture the water from below the instream flow reach of South Boulder Creek. Louisville's water rights are diverted above the instream flow reach. Therefore, Louisville's ability to provide environmental enhancement and recapture Gross Reservoir releases for later City use has proven to be problematic.

The remaining parties continue to negotiate final terms (volume amounts and capital storage costs). Previously, Louisville has made proposals to the other parties to cost-share expenses associated with Gross Reservoir storage (since 2007), but without a legal water storage supply and identified, tangible environmental benefits, Louisville cannot meet the re-permitting requirements.

Amount of Water to Purchase

The amount of water required to adequately supply the City during the design-drought duration is contingent on: (1) risk assessment; (2) estimated costs; and (3) other adopted alternatives. Currently the City has an average demand of approximately 4,250 AF/year. Current firm yield supplies are estimated at 5,000 AF/year. Therefore, in the near-term planning period, Louisville's supply is sufficient to meet historical average demands. With load-shifting and water conservation management, the City's firm yield can be increased to 6,500 AF/year.

Based on review of historical records and City staff discussions, the 6,500 AF build-out scenario was used as the baseline annual demand for this report. At this level, the current firm yield supplies are adequate to meet the City's raw water demands with the implementation of the No Additional Action Alternative. However, due to inherent inefficiencies in the City's raw water transmission and distribution system, it is recommended that the City consider increasing its raw water supplies and/or storage to add 200 AF of C-BT units, Windy Gap units, or Marshall Division shares.

If the build-out demand is higher than 6,500 AF then additional water supplies and/or additional storage capacity will be needed. If the City water demand reaches the 7,120 AF/year level, there is a potential shortfall of 620 AF/yr at this build-out demand level.

To cover potential future water supply deficits which would result from demands exceeding 6,500 AF/year, the City will need additional water supply (from sources listed above) and/or storage acquisition. However, the following issues should also be considered with such purchases:

- C-BT purchases are limited to 400 units without increasing our contribution to Windy Gap
- Windy Gap Firming -- is considered best suited for drought protection rather than used to increase average annual supply because of high cost of acquisition and operation
- South Boulder Creek water rights include the uncertainty related to water court proceedings, in stream flows, and other administrative constraints
- In general, without additional storage, relatively more senior rights are required to address the shortfall. However, senior water rights comprise a smaller segment of the water market and, as a result, are relatively more expensive than other less senior (but more abundant) water rights.
- Marshall Lake shares include a storage component, increasing their value for City use

- Raw water supply needs are subject to change due to any of the following reasons: (1) future changes in water operations, (2) development of future cooperative agreements, (3) increase in city-wide storage capacity, (4) revised lower demand projections.

OTHER CONSIDERATIONS

General Cooperative Partnerships

Louisville has existing water/storage supply-related agreements with several entities including:

- Annual water supply leases - Asphalt Specialties, Three Leaf Farms
 - 2016 Lease Amount is 20 AF/yr
- Use of Louisville Pipeline for augmentation bypasses - Eldorado Springs
 - Approximately 10 AF during 2015 water year
- Use of Louisville Pipeline as an alternate point of diversion - City of Lafayette
 - Legal right, not contractual right

The Asphalt Specialties, Three Leaf Farm, and Eldorado Springs agreements are currently under review to assess the following:

- Policy strategies for renewing lease contracts (Asphalt and Three Leaf Farm);
 - Honor existing leases
 - Add new leases only on an annual basis - to the extent water is available.
- Louisville Pipeline Use -
 - Review and revise existing terms and conditions regarding the Facility Use Agreement with Eldorado Springs.

Future partnerships are anticipated regarding potential South Boulder basin local storage, basin-wide water right administration and management, and the possibility (and feasibility) of developing South Boulder Creek cooperative opportunities. Initial discussions with local entities are needed to develop the structure and process associated with these partnerships- with a primary focus on current basin-wide issues and future planning. Potential participants in these partnerships include water users in District 6 and, to the extent necessary, the users located on the lower St. Vrain and South Platte Rivers.

McKay Reservoir Conveyance

McKay Reservoir has the potential to supply replacement water for the City's return flow obligations, including Marshall Division shares, which could alleviate the need for such replacements to be made from Marshall Lake or the City's wastewater treatment plant. However, without an approved conveyance, such replacements from McKay Reservoir are not physically possible.

Negotiations with other water users to allow for water deliveries have been undertaken and are anticipated to continue. Discussions need to focus on Louisville's (and others) requirement to make return flow replacements. Recent rulings from similar water court proceedings indicate that future

similar requirements will be imposed on water right transfers associated with Marshall Lake Division shares. Current and projected terms of water supplies will create a higher demand for McKay Reservoir releases to supply municipal replacement obligations in time, place a location of the historical depletions (including Louisville's). This effectively eliminates the ability to deliver such return flows replacements from the City's wastewater treatment plant. Therefore, full compliance with Louisville's water court decrees will require a new conveyance structure. Final costs will depend on cost sharing arrangement with other parties involved and the type of engineering solutions selected to allow McKay Reservoir releases.

State of Colorado Water Plan

A recently published statewide water plan, developed by the Colorado Water Conservation Board, has indicated more cooperative operations are needed to address the projected shortfall of municipal water supplies in the state. Specifically, the plan identifies the need for increased flexibility to provide municipal water supplies during droughts. This flexibility can be achieved through cooperative agreements between water users within the basin, e.g. interruptible water supplies and water banking.

The state-wide plan recommends basin-wide cooperative planning among local water users. However, currently there is no formal planning forum for South Boulder Creek water right holders. Therefore, to implement the state plan, a District 6 water forum needs to be established with representation from the various District 6 water users. The purpose of the forum would be to discuss: (1) current water supplies/storage; (2) near-term basin-wide operations; (3) future water right operations; (4) watershed protection strategies, and (5) improved communication among the participants.

State of Colorado, Division of Water Resources, Water Rights Accounting Audit

Louisville began the audit process with the Colorado Division of Water Resources in 2014 to standardize the City's accounting forms, reporting procedures, and accounting process. This audit phase currently continues revisions to the accounting forms and procedures, with review and comment from the Division 1 Engineer, and the State Engineer's Office. It is anticipated that the audit process will be completed by December, 2017.

SUMMARY

The purpose of this report was to provide Louisville with an analysis related to its current and future water supply and use. Results indicate that the City has a firm yield of 6,500 AF/yr, with a current annual demand of 4,250 AF/yr. Three projected water demand levels were used to evaluate whether current water supplies are sufficient to meet the City's future growth. Results indicated that current raw water supplies were adequate to meet all but the highest demand level: 7,120 AF/yr.

To accurately appraise these results, several assumptions need to be identified when considering the outcomes described above:

- The modeling analysis assumed current storage capacities are an accurate representation of existing conditions.

- The Louisville Pipeline's recent diversion rate is around 5.0 cfs. This was based on typical historical use of the pipeline rather than the original design flow rate of 7.7 cfs.
- To the extent water and storage/demand was available, it was assumed in the original modeling analysis that Louisville diverted water to its fullest legal entitlement. However, in practice, full efficiency in water diversions and deliveries is unrealistic. Historical diversion/delivery records clearly indicate that there were several occasions whereby water was available but not diverted. Therefore, appropriate modifications were made to reflect practical constraints limiting the City's ability to divert at the highest rates, most notably regarding the two pipelines.
- To achieve the firm yield of 6,500 AF/yr with current water supplies it is anticipated that the City will need to increase its current level of water resource management, specifically daily administration and operations. This includes providing the capability to divert, deliver, and store all available water. As a result, higher daily management is required to achieve this level of water operations.
- Three future City-wide water demand levels were chosen for this analysis based on previous reports and estimates. Further refinement of these three City's future build-out demand estimates is warranted to specifically target the amount of any water supply shortfall.

This report identifies a variety of water resource management alternatives designed to meet all future City water demands. However, the intent was not to present these individual alternatives mutually exclusive of each other. To the contrary, it is anticipated that a combination of alternatives will be adopted to achieve the desired goals. It is also anticipated changes and modifications will be necessary to update the information contained in this report. As the City develops into its build-out scenario in 2065, review of this document is warranted on 2-5 year basis, rather than the previous 10-year review.

Table 4
Summary of Capital Improvement Alternatives

| Alternative | Increased Yield (AF) | Cost/AF | Difficulty (1-5)* | Total Cost |
|--------------------------------|----------------------|---------------|-------------------|-----------------|
| Enlarge SWSP Pipeline Capacity | 800 | \$10K - \$18K | 3 | \$1-3 Million |
| Marshall Lake Forebay | 600 - 1000 | \$20K - \$25K | 5 | \$12-25 Million |
| Dredge Marshall Lake | 400 * | \$10K | 3 | \$4 Million |
| Water Purchase | 250 * | \$22K - \$28K | 5 | \$4-7 Million |
| Gross Reservoir Storage | 250 * | \$10K - \$20K | 5+ | \$2.5-5 Million |

* 1-5 = easy to difficult transaction level

** Estimated yield unknown - only estimates provided

RECOMMENDATIONS

After considering the information gathered, the Louisville Staff has the following specific recommendations:

- Maintain the Design Drought period of 1963-1965
- Proceed with the SWSP Transmission Capacity Project
- Continue participation in the Windy Gap Firming Project
- Develop and implement load shift operational procedures
- Maintain and expand the Water Conservation Program
- Finalize McKay Reservoir negotiation
- Perform bathometric survey of Marshall Lake
- Utilize a build-out demand projection of 6,700 acre-feet for short term acquisition strategy
- Update the current Drought Management Plan
- Update the current City's water demand projections at Louisville's build-out use (Year 2065)
- Acquire up to 200 acre-feet of additional water supplies by purchasing C-BT units, and/or FRICO's Marshall Division shares, and/or South Boulder and Coal Creek Ditch shares.